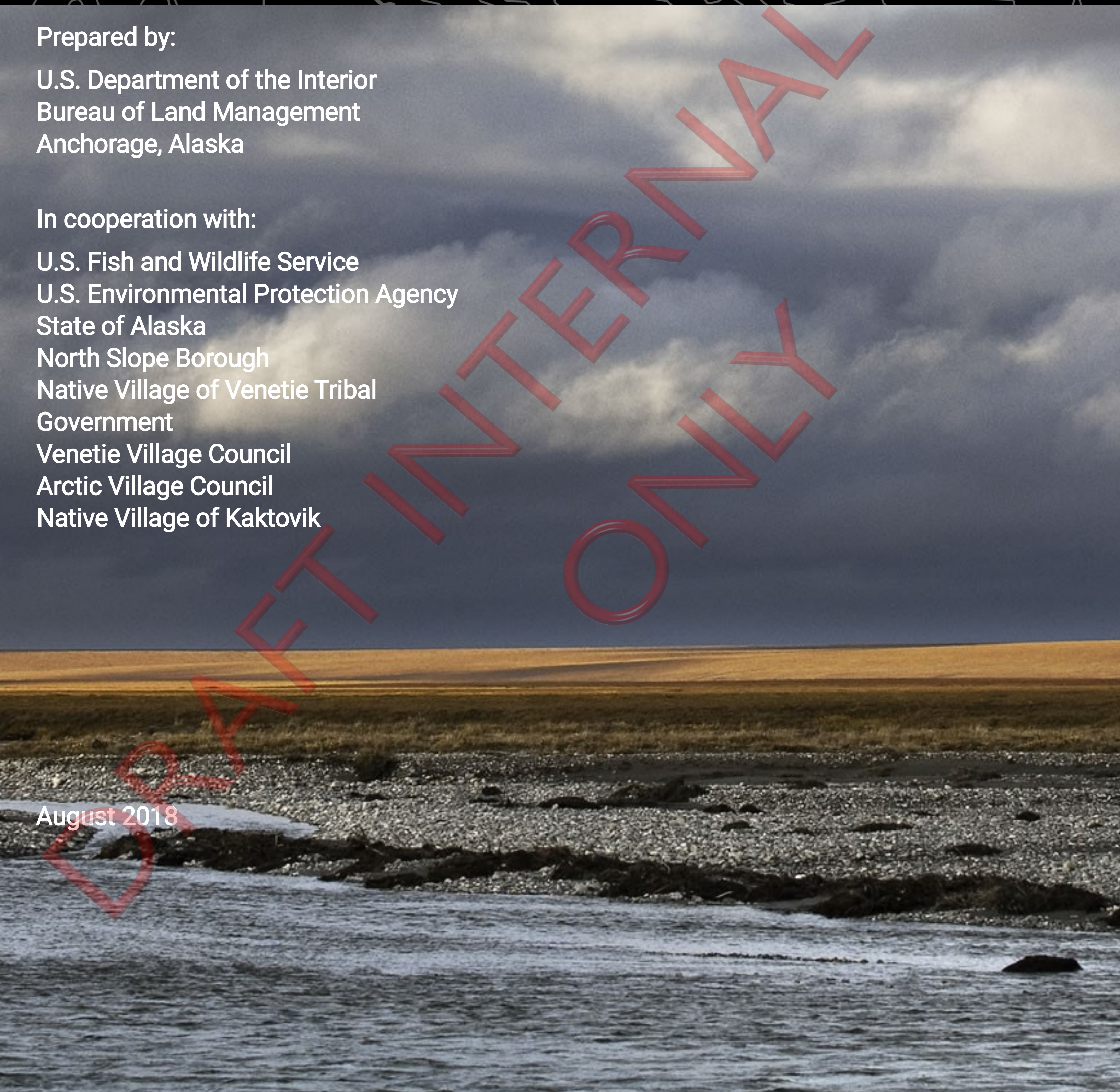
U.S. Department of the Interior
Bureau of Land Management

Coastal Plain Oil and Gas Leasing Program Draft Environmental Impact Statement

Volume I: Executive Summary, Chapters 1-3, References, Glossary



Prepared by:

U.S. Department of the Interior
Bureau of Land Management
Anchorage, Alaska

In cooperation with:

U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
State of Alaska
North Slope Borough
Native Village of Venetie Tribal Government
Venetie Village Council
Arctic Village Council
Native Village of Kaktovik

August 2018

The Bureau of Land Management's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

Cover Photo: Jeff Jones

In Reply Refer To
XXXX (XXXXXX)

October 2018

Dear Reader:

We are pleased to present the Coastal Plain Oil and Gas Leasing Program Draft Environmental Impact Statement (Leasing EIS) for your review. It addresses a list of issues and contains a range of four action alternatives for the Bureau of Land Management's (BLM's) future implementation of an oil and gas program in the Coastal Plain of the Arctic National Wildlife Refuge (Arctic Refuge). This program was required by the Tax Cuts and Jobs Act of 2017.

The Coastal Plain is within the political boundary of the North Slope Borough and is predominantly managed by the US Fish and Wildlife Service. The decisions to be made as part of this Leasing EIS concern which areas of the Coastal Plain would be offered for oil and gas leasing and the terms and conditions of the leases.

The alternatives discussed in the Leasing EIS include stipulations and required operating procedures designed to mitigate impacts on resources and their uses. The decisions evaluated would not authorize any activity associated with the exploration or development of oil and gas resources on the Coastal Plain. Future actions requiring BLM approval, including proposed exploration plans and development proposals, would require further National Environmental Policy Act analysis.

While preparing this EIS we will consider and evaluate all comments received and will address substantive comments in the Final Leasing EIS, to be completed in 2019.

The most useful comments are specific and address one or more of the following:

- Identification of new information that would have a bearing on the analysis
- Inaccuracies or discrepancies in information, or any errors in our portrayal of the resources and uses of the program area
- Suggestions for improving implementation of an oil and gas leasing program, consistent with the purposes of the Arctic Refuge
- Identification of new impacts, alternatives, or potential mitigation measures.

When you share your comments with us, please be as specific as possible. Identify the specific concern or correction you are suggesting, where it appears in the Draft Leasing EIS, and the modification you feel is necessary. If you have an idea for a potential mitigation measure, please tell us what it is and the benefits it would provide.

We appreciate your comments on this Draft Leasing EIS. There are four ways to get your ideas to us:

- You may go to our plan's online site and comment electronically. The website address is: https://goo.gl/HVo5Mj

- You may write to us at:

  Ms. Nicole Hayes
  BLM Alaska State Office
  222 West 7th Avenue
  Anchorage, AK 99513

- You may hand deliver your comments to us at the BLM Public Information Center in the Federal Building, 222 W. 7th Avenue, Anchorage. You can also deliver comments to us at the public meetings on the Draft Leasing EIS.
- You may speak at public meetings on the Draft Leasing EIS that will be held before the close of the comment period. We will announce the meeting dates, times, and specific locations through our website, public notices, news releases, and other mailings.

The public comment period for the Draft Leasing EIS will last 45 days and will begin with the notice of availability published by the BLM in the *Federal Register*. The precise dates of the comment period, as well as information about public meetings and subsistence hearings pursuant to Section 810 of the Alaska National Interest Lands Conservation Act, will be found on the BLM's website address noted above and in the notice of availability.

The BLM will review all submitted public comments for this Draft Leasing EIS. The comments will be available for public review and may be published as part of the Final Leasing EIS. Before including your address, phone number, email address, or other personal identifying information in your comment, be aware that your entire comment, including your personal identifying information, may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. All submissions from organizations and businesses and from individuals identifying themselves as representatives or officials of organizations and businesses will be available for public inspection in their entirety.

If you have questions about the public comment process or this Draft Leasing EIS, please call Nicole Hayes, Project Manager at (907) 271-4354.

Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1 (800) 877-8339 to contact Ms. Hayes during normal business hours. The FIRS is available 24 hours a day, 7 days a week, to leave a message or question. You will receive a reply during normal business hours.

Sincerely,

Joseph Balash
Assistant Secretary for Lands and Minerals Management
US Department of the Interior

Coastal Plain Oil and Gas Leasing Program
Draft Environmental Impact Statement

Lead Agency: United States Department of the Interior, Bureau of Land Management (BLM)

Cooperating Agencies: US Fish and Wildlife Service, US Environmental Protection Agency (EPA), State of Alaska, North Slope Borough, Native Village of Venetie Tribal Government, Venetie Village Council, Arctic Village Council, and the Native Village of Kaktovik

Proposed Action: In accordance with the Tax Cuts and Jobs Act of 2017, Public Law 115-97 (Tax Act), establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain area within the Arctic National Wildlife Refuge (Arctic Refuge)

Abstract: The BLM will establish and administer an oil and gas leasing program for the Coastal Plain area within the Arctic Refuge, as required by the Tax Cuts and Jobs Act of 2017. With the Coastal Plain Oil and Gas Leasing Program Draft Environmental Impact Statement (Leasing EIS), the BLM is implementing the requirement of the Tax Act to hold multiple lease sales and to permit associated post-lease activities. The Leasing EIS considers three action alternatives. The No Action Alternative is included for comparison only; it does not meet the purpose and need of the EIS. There is no preferred alternative. Alternative D contains two sub-alternatives, Alternatives D1 and D2, for varied analysis of caribou summer habitat stipulations. The alternatives propose a range of the extent of the Coastal Plain that would be available for lease sale—from 67 to 100 percent of the 1.6 million-acre Coastal Plain—while balancing biological and ecological concerns. The alternatives also include stipulations and required operating procedures designed to mitigate impacts on resources and their uses. The Leasing EIS evaluates the potential direct, indirect, and cumulative effects on climate and meteorology, air quality, noise, physiography, geology and minerals, petroleum resources, paleontological resources, sand and gravel, soil and water, vegetation, wetlands and floodplains, wildland fire, wildlife, land ownership and uses, cultural resources, subsistence use and harvest, sociocultural systems, environmental justice, recreation, visual resources, special designations (including marine protected areas, wilderness characteristics, qualities, and values, and Wild and Scenic Rivers), transportation, public health, and the economy.

Review Period: The review period on the Leasing EIS is 45 calendar days. The review period began when the EPA published a notice of availability in the *Federal Register* on October 19, 2018. The comment period ends on December 3, 2018.

Further Information: Contact Nicole Hayes of the BLM at (907) 271-4354 or visit the Leasing EIS website at https://goo.gl/HVo5Mj.

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APPENDICES

ACRONYMS AND ABBREVIATIONS

	Full Phrase
μg/m3	micrograms per cubic meter
AAAQS	Alaska Ambient Air Quality Standards
ACCS	Alaska Center for Conservation Science
ACP	Arctic Coastal Plain
ACRC	Alaska Climate Research Center
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
AGL	above ground level
AHRS	Alaska Heritage Resources Survey
AIRFA	American Indian Religious Freedom Act
AIS	Automatic Identification System
ADNR	Alaska Department of Natural Resources
ADNR MLW	Alaska Department of Natural Resources, Division of Mining, Land and Water
ADNR OHA	Alaska Department of Natural Resources, Office of History and Archaeology
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act of 1980
ANWR	Arctic National Wildlife Refuge
ADOLWD	Alaska Department of Labor and Workforce Development
APD	Advanced Planning Document
AQRV	air quality related value
ARCP	Arctic Refuge Coastal Plain
[Arctic] Refuge	Arctic National Wildlife Refuge
ARF	Anaktuvuk River Fire
ARPA	Archaeological Resources Protection Act
asl	above sea level
ASRC	Arctic Slope Regional Corporation
AWOS	automated weather observing system
BBO	billion barrels of oil
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BOPD	barrels of oil per day
C&T	Customary and Traditional Use Determinations
CAA	conflict avoidance agreement
CAH	Central Arctic Herd
CASTNET	Clean Air Status and Trends Network
CATG	Council of Athabascan Tribal Governments
CCP	Comprehensive Conservation Plan
CCR	Chumis Cultural Resource Services
CFFDRS	Canadian Forest Fire Rating System
CFR	Code of Federal Regulations
CO	carbon monoxide

CO_2	carbon dioxide
COA	condition of approval
CPF	central processing facility
CSU	controlled surface use
CWA	Clean Water Act
dB	decibels
dBA	A-weighted decibel
DEC	Alaska Department of Environmental Conservation
DEIS	Draft Environmental Impact Statement
DEW	Defense Early Warning
DOD	Department of Defense
DOI	Department of Interior
dv	deciview
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FLIR	forward-looking infrared radiometry
FLPMA	Federal Land Policy and Management Act
FMP	Arctic Fire Management Plan
FMU	Fire Management Unit
FY	fiscal year
GFUR	general fund unrestricted revenue
GHG	greenhouse gas
GIS	Geographic Information System
GMT2	Greater Moose's Tooth 2
GPS	Global Positioning System
HCP	hydrocarbon potential
IBA	Important Bird Area
ICAS	Iñupiat Community of the Arctic Slope
IMPROVE	Interagency Monitoring for the Protection of Visual Environments
IRA	Indian Reorganization Act
ITR	Incidental Take Regulation
kg/ha-hr	kilograms per hectare per hour
kg/ha-yr	kilograms per hectacre per year
KIC	Kaktovik Iñupiat Corporation

KSOPI	Kuukpik Subsistence Oversight Panel, Inc.
Leasing EIS	Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement
LOA	Letter of Authorization
LRRS	long-range radar sites
M	magnitude
m/yr	meters per year
MMPA	Marine Mammal Protection Act
MMT	million metric tons
MPA	Marine Protected Area
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NDVI	Normalized Difference Vegetation Index
NEPA	National Environmental Protection Act
NHPA	National Historic Preservation Act
NLUR	Northern Land Use Research
NM	nautical mile
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanographic and Atmospheric Administration
NOAA OCS	National Oceanic and Atmospheric Administration, Office of Coast Survey
NPDES	National Pollutant Discharge Elimination System
NPR-A	National Petroleum Reserve Alaska
NSB	North Slope Borough
NSO	no surface occupancy
NWI	National Wetland Inventory
NWSRS	National Wild and Scenic River System
ORV	outstandingly remarkable value
PCH	Porcupine Caribou Herd
PDO	Pacific decadal oscillation
PFYC	Potential Fossil Yield Classification
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
REA	North Slope Rapid Ecoregional Assessment
RFD	reasonably foreseeable development
ROD	record of decision
ROP	required operating procedure
SBS	Southern Beaufort Sea
SCC	social cost of carbon
SEIS	Supplemental Environmental Impact Statement

SO	Secretarial Order
SO_2	sulfur dioxide
STC	standard terms and conditions
STP	seawater treatment plant
TAPS	Trans-Alaska Pipeline System
TCF	trillion cubic feet
TCP	Traditional Cultural Property
TL	timing limitation
TLUI	Traditional Land Use Inventory
TK	traditional knowledge
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VHF	very high frequency
VRI	Visual Resource Inventory
VSM	vertical support member
WACS	White Alice Communications System
WRCC	Western Regional Climate Center
WSR	Wild and Scenic River

Executive Summary

Introduction

On December 22, 2017, the Tax Cuts and Jobs Act of 2017, Public Law 115-97 (Tax Act) was signed. Title II, Section 20001 of the Tax Act directs the Secretary of the Department of the Interior (Secretary) to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Coastal Plain area in the Arctic National Wildlife Refuge (Arctic Refuge). The Secretary has delegated the US Department of the Interior, Bureau of Land Management (BLM) to oversee the leasing oil and gas program. Implementing an oil and gas program in the Coastal Plain is consistent with Executive Order 13783 (82 *Federal Register* 16093, March 31, 2017), "Promoting Energy Independence and Economic Growth."

The Tax Act requires that at least two lease sales be held by December 22, 2024, and that each sale offer for lease at least 400,000 acres of the highest hydrocarbon potential lands in the Coastal Plain, allowing for up to 2,000 surface acres of federal land to be covered by production and support facilities. The oil and gas leasing program must be consistent with Section 303 (2)(B) of Alaska National Interest Lands Conservation Act (ANILCA), which established the purposes of the Arctic Refuge.

Purpose and Need

The BLM has produced this Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS) to implement the leasing program, as required by the Tax Act. The purpose of the Leasing EIS is to inform the BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities: seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain.

Specifically, in the Leasing EIS the BLM considered and analyzed the environmental impact of various leasing alternatives, including the areas to offer for sale and the terms and conditions—the lease stipulations and required operating procedures—to be applied to leases and associated oil and gas activities. These are intended to properly balance oil and gas development with the protection of surface resources. They also are meant to limit the footprint of production and support facilities on federal lands to no more than 2,000 surface acres.

Decisions to be Made

The BLM's decisions will include which tracts of land will be offered for lease and the terms and conditions to be applied to such leases. The decisions evaluated in this Leasing EIS would not authorize any activity associated with the exploration or development of oil and gas resources on the Coastal Plain. Future actions requiring BLM approval, including proposed exploration plans and development proposals, would require further National Environmental Policy Act of 1969 (NEPA) analysis.

Program Area

The program area includes all federal lands and waters that make up the approximately 1.6 million acres of the Coastal Plain in the 19.3-million-acre Arctic Refuge (see **Table ES-1** and **Map 1-1**, Program Area [**Appendix A**, Maps and Figures]). The program area excludes a northern coastal portion of

Table ES-1
Land Administration of Areas in Public Law 115-97, Coastal Plain

Land Administration	Acres
USFWS	1,423,800
Water	138,800
Native allotment	900
Total	**1,563,500**

Source: BLM GIS 2018
Note: Acreages are rounded up or down to nearest 100.

BLM-administered lands and Air Force-administered lands near Kaktovik. Lands outside the BLM's oil and gas leasing authority are those excluded from Public Law 115-97, Native selected lands, and interim-conveyed lands.

Scoping and Issues

As part of the scoping process, the BLM considered public responses provided during scoping meetings held in Arctic Village, Fairbanks, Anchorage, Utqiaġvik, Venetie, and Kaktovik, and in Washington, DC, during May and June 2018. It also considered public comments submitted during the scoping period and input from cooperating agencies and tribes. For more information on the scoping process, see the final scoping report on the BLM's project website: https://goo.gl/HVo5Mj.

Issues, such as fish and wildlife (including Porcupine caribou herd), special status species (including polar bear), analysis of oil and gas activities, and subsistence use and traditional ways of life, were identified during scoping and addressed in this Leasing EIS. The full list of issue summaries is available in the final scoping report.

Alternatives

Alternative A—No Action Alternative

Under Alternative A (No Action Alternative), no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales after the record of decision (ROD) for this EIS is signed. Alternative A would not include the direction under the Tax Act to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Coastal Plain in the Arctic Refuge. Under this alternative, current management actions would be maintained, and resource trends would continue, as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015).

Alternative A would not meet the purpose of this EIS to inform the BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities; however, Alternative A is being carried forward for analysis to provide a baseline for comparing impacts under the action alternatives.

Alternative B

Alternative B emphasizes oil and gas leasing in the Coastal Plain. The entire Coastal Plain could be offered for lease sale and there would be the fewest acres with major, moderate, and minor stipulations. The BLM would rely largely on site-specific surveys at the time of development to apply required

operating procedures (ROPs) and design features as conditions of approval. Approximately 1,563,500 acres would be offered for lease, 264,100 acres would be subject to a no surface occupancy (NSO) stipulation, and 844,400 acres would be subject to timing limitations (TLs). Standard terms and conditions would apply to approximately 455,000 acres.

Alternative C

Alternative C balances oil and gas leasing with biological and ecological concerns throughout the Coastal Plain. The BLM would rely on the same ROPs as under Alternative B, but more stipulations would apply. Approximately 1,086,900 acres would be offered for lease, 389,800 acres would be subject to NSO, and 350,700 acres would be subject to TLs. Standard terms and conditions would apply to approximately 346,400 acres.

Alternative D

Alternative D emphasizes biological and ecological concerns in the Coastal Plain. Portions of the Coastal Plain would not be offered for lease sale out of concern for biological end ecological resources. Surface occupancy would also not be permitted in these areas. In some instances, more prescriptive ROPs are analyzed under Alternative D, as compared with Alternatives B and C.

Alternative D contains two sub-alternatives, Alternatives D1 and D2, for the issue of caribou summer habitat. The two sub-alternatives explore alternate ways to mitigate impacts on caribou summer habitat through minor constraints or ROPs. Under both sub-alternatives, approximately 1,037,200 acres would be offered for lease, 708,600 acres would be subject to NSO, and 123,900 acres would be subject to controlled surface use. Alternative D1 would have no areas subject to TLs and approximately 204,700 acres subject to standard terms and conditions. Alternative D2 would have approximately 204,700 acres of TLs and no areas subject to standard terms and conditions.

The complete list of stipulations and ROPs under each alternative are presented in **Table 2-2** in **Chapter 2**.

REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

A reasonably foreseeable development (RFD) scenario for oil and gas exploration, development, production and abandonment activity in the Coastal Plain was developed to analyze the environmental impacts of future leasing and development over the next 20 years. An estimated 427,900 acres of the program area is high potential for petroleum resources, 657,900 acres are moderate potential, and 476,900 acres are low potential. This RFD scenario projects a hypothetical baseline scenario of activity, assuming all potentially productive areas can be open under standard lease terms and conditions, except those areas designated by law as closed to leasing.

The baseline RFD scenario provides the mechanism to analyze the effects that discretionary management decisions have on oil and gas activity. Depending on the stipulations, ROPs, and standard terms and conditions of the alternatives, different scenarios were developed for their development to provide a future scenario for analyzing impacts on resources.

The program area contains an estimated 7.687 billion barrels of technically recoverable oil and 7.041 trillion cubic feet of technically recoverable natural gas. Due to high costs associated with operating in the arctic, it is extremely unlikely that all technically recoverable resources would be produced. The US

Energy Information Administration estimated that approximately 3.4 billion barrels of oil would be produced in the Arctic Refuge from 2031 to 2050 (EIA 2018). No natural gas production is anticipated within the time frame of this document, due to low natural gas prices and a lack of infrastructure to transport gas to market. See the Reasonably Foreseeable Development Scenario (**Appendix E**) for more information on development potential, assumptions behind potential estimates, and estimates for the baseline and alternatives development scenarios for petroleum.

Impact Analysis

Offering lands for oil and gas leasing, in and of itself, does not cause any direct impacts, as defined by Council on Environmental Quality regulations, which states that such effects "are caused by the action and occur at the same time and place" (40 Code of Federal Regulations 1508.8[a]); however, it is reasonable to foresee that on-the-ground impacts would occur if the BLM were to issue leases but that the impacts would not occur until approximately 5 to 10 years after the ROD is signed; therefore, the analysis in the draft Leasing EIS addresses both direct and indirect impacts, based on the foreseeable on-the-ground actions, including exploration and development. These impacts cannot be analyzed site specifically, but they are analyzed for the program area, based on the RFD scenario. Additional site-specific analysis would be conducted during the permitting review process for subsequent exploration and development applications.

If leases were developed, the following general impacts would be expected:

- Impacts on water quality caused by water extraction and construction of ice roads and pads, gravel mining, and central processing facility
- Impacts from routine activities on air quality due to release of pollutants
- Greenhouse gas emissions from exploration and development
- Potential impacts on birds from predators and increased human presence
- Potential impacts on marine mammals caused by activities, such as accidental, unplanned occurrences from vessel strikes or oil spills
- Impacts on terrestrial mammals, including vehicle and aircraft noise and traffic, surface disturbance, and human presence
- Disturbance and loss of permafrost, vegetation, and wetlands
- Potential beneficial effects on state employment, labor income, and revenues
- Beneficial impacts on North Slope Borough (NSB) employment and income, as well as revenue
- Loss of some recreational opportunities from energy infrastructure
- Long-term visual impact from infrastructure
- Potential adverse effects on subsistence users from routine construction, development, production, and decommissioning, including marine mammals, caribou, waterfowl, and fish

Kaktovik is the primary user of the program area and would therefore be most likely to experience direct impacts from development. Nuiqsut has the potential to experience direct and indirect impacts on marine harvests and indirect impacts on caribou, waterfowl, and fish harvests. Arctic Village, Venetie, and other communities that use the Porcupine and Central Arctic caribou herds could experience indirect impacts on caribou and, to a lesser extent, waterfowl.

Collaboration and Coordination

The BLM is the lead agency for this Leasing EIS. Cooperating agencies participating in this EIS are the USFWS, US Environmental Protection Agency, State of Alaska, NSB, Native Village of Venetie Tribal Government, Venetie Village Council, Arctic Village Council, and the Native Village of Kaktovik.

The BLM, as the lead federal agency, coordinated directly with federally recognized tribal governments during preparation of this Leasing EIS. The BLM has contacted the Arctic Village Traditional Council, the Inupiat Community of the Arctic Slope, the Native Village of Kaktovik, the Native Village of Venetie, the Native Village of Venetie Tribal Government, Beaver Village Council, Birch Creek Village Council, Chalkyitski Village Council, Gwitchyaa Zhee Gwich'in Tribal Government (Fort Yukon), Naqsragmiut Tribal Council (Anaktuvuk Pass), Native Village of Barrow Iñupiat Traditional Government, Native Village of Fort Yukon, Native Village of Nuiqsut, and the Native Village of Stevens.

The BLM offered these entities the opportunity to participate in formal government-to-government consultation, to participate as cooperating agencies, or to simply receive information about the project. The dates and locations of government-to-government meetings that have taken place are provided in **Appendix B**.

The BLM also contacted Arctic Slope Regional Corporation and Kaktovik Inupiat Corporation, offering the opportunity to participate in formal government-to-government consultation. The BLM has held consultation meetings with both Alaska Native Claims Settlement Act of 1971 Corporations and Doyon, Limited, to discuss the EIS process (see **Appendix B**).

The BLM is consulting with the Alaska State Historic Preservation Office, in accordance with Section 106 of the National Historic Preservation Act of 1966. This is to determine how proposed activities could affect cultural resources listed on or eligible for listing on the National Register of Historic Places.

To comply with Section 7(c) of the Endangered Species Act of 1973 (ESA), the BLM consulted the USFWS early in the EIS process. The USFWS provided input on planning issues, data collection and review, and alternatives development. The BLM will consult with the USFWS to identify ESA issues and to develop the draft biological assessment.

The analysis required by ANILCA Section 810 reached a finding of "X" (see **Appendix C**, ANILCA Section 810 Analysis of Subsistence Impacts); consequently, the BLM notified the State of Alaska and the North Slope Federal Subsistence Regional Advisory Council of this finding and XX [Note to BLM: this section to be completed prior to DOI Review Team review].

Chapter 1. Introduction

1.1 Introduction

Section 1003 of the Alaska National Interest Lands Conservation Act of 1980 (ANILCA) specifically prohibited oil and gas exploration, leasing, development, and production in the Arctic National Wildlife Refuge (Arctic Refuge). Congressional authorization to conduct an oil and gas exploration program in the Coastal Plain expired on June 1, 1987, when the US Department of Interior (DOI) provided Congress with a report and record of decision (ROD) on the future management of the Coastal Plain, in compliance with ANILCA 1002(h). From June 1987 to December 2017 there was no legal authority to allow oil and gas exploration, leasing, development, or production in the Arctic Refuge.

On December 22, 2017, the Tax Cuts and Jobs Act of 2017, Public Law 115-97 (Tax Act) was signed. Title II, Section 20001 of the Tax Act directs the Secretary of the DOI (Secretary) to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain area in the Arctic Refuge. The Secretary has delegated to the Bureau of Land Management (BLM) the responsibility for overseeing the leasing oil and gas program. Implementing an oil and gas program in the Coastal Plain is consistent with Executive Order 13783 (82 Federal Register 16093, March 31, 2017), "Promoting Energy Independence and Economic Growth".

The Tax Act requires that at least two lease sales be held by December 22, 2024, and that each sale offer for lease at least 400,000 acres of the highest hydrocarbon potential lands in the Coastal Plain, allowing for up to 2,000 surface acres of federal land to be covered by production and support facilities. The oil and gas leasing program must be consistent with Section 303 (2)(B) of ANILCA, which establishes the purposes of the Arctic Refuge.

This document may be translated into a language other than English to facilitate public participation in the decision process. The English-language version has been prepared by BLM and is the official version of the document for all purposes. Any translated version of this document has been prepared for the convenience of non-English-speaking members of the public. In the event of any discrepancy, the English-language version controls.

1.2 Purpose and Need

The BLM has produced this Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS) to implement the leasing program, as required by the Tax Act. The purpose of the Leasing EIS is to inform the BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities: seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain.

Specifically, in the Leasing EIS the BLM considered and analyzed the environmental impact of various leasing alternatives, including the areas to offer for sale and the terms and conditions—the lease stipulations and required operating procedures (ROPs)—to be applied to leases and associated oil and gas activities. These are intended to properly balance oil and gas development with the protection of surface resources. They also are meant to limit the footprint of production and support facilities on federal lands to no more than 2,000 surface acres.

1.3 Decisions to be Made

The BLM's decisions will include which tracts of land will be offered for lease and the terms and conditions to be applied to such leases. The decisions evaluated in this Leasing EIS would not authorize any activity associated with the exploration or development of oil and gas resources on the Coastal Plain. Future actions requiring BLM approval, including proposed exploration plans and development proposals, would require further National Environmental Policy Act of 1969 (NEPA) analysis. It would be based on specific and detailed information about what kind of activity is proposed and where it will take place. The BLM authorized officer may require additional site-specific terms and conditions before authorizing any oil and gas activity.

1.4 Program Area

The Coastal Plain is in the North Slope Borough (NSB), a political subdivision of Alaska. Landownership in the NSB is complex. The US Fish and Wildlife Service (USFWS) is the predominant landowner of onshore lands; most of the NSB's land area is within the Arctic Refuge. Other surface lands are Native lands and Native allotments (see **Table 1-1**).

The Coastal Plain program area was previously referred to as the 1002 Area. The program area includes all federal lands and waters comprising the approximately 1.6 million acres of the 1002 Area within the 19.3 million-acre Arctic Refuge (**Map 1-1**, in **Appendix A**). The program area excludes a northern coastal portion of BLM-administered lands and Air Force-administered lands near Kaktovik. Lands outside BLM's oil and gas leasing authority include lands excluded from Public Law 115-97, Native selected lands, and interim-conveyed lands.

Table 1-1
Land Administration of Areas in Public Law 115-97, Coastal Plain

Land Administration	Acres
USFWS	1,423,800
Water	138,800
Native allotment	900
Total	**1,563,500**

Source: BLM GIS 2018
Note: Acreages are rounded up or down to nearest 100.

1.5 Scoping and Issues

The BLM conducted formal scoping for the Leasing EIS following publication of a Notice of Intent in the *Federal Register* on April 20, 2018. In May and June 2018, the BLM held scoping meetings in Alaska, in Arctic Village, Fairbanks, Anchorage, Utqiaġvik, Venetie, and Kaktovik, and in Washington, DC. Verbal comments were captured by a court reporter at all meetings. The BLM formally accepted scoping comments through June 15, 2018; scoping comments received after that date were considered when developing alternatives and additional mitigation measures to be considered. For more information on the scoping process, see the final scoping report on the BLM's project website: https://goo.gl/HVo5Mj.

The following summaries highlight a few of the issues identified during scoping and addressed in this Leasing EIS. The full list of summaries is available in the final scoping report.

- **Fish and Wildlife—**Commenters stated concerns about impacts on fish and wildlife, including the Porcupine caribou herd, large terrestrial mammals, marine mammals, migratory birds, and fish and other aquatic species. Potential impacts on the Porcupine caribou herd were of particular concern. Commenters requested that the EIS evaluate the use and importance of the Coastal Plain to herd movement during different life stages and seasons and how the proposed program might affect calving grounds, insect relief areas, and migration routes.
- **Special Status Species—**Commenters noted that the proposed program could reduce and fragment available terrestrial denning habitat for the Southern Beaufort Sea subpopulation of polar bear, which is listed as threatened under the Endangered Species Act of 1973 (ESA). Commenters requested that the EIS analyze impacts on all special status species, including marine mammals, such as ringed seals, bearded seals, and bowhead whales.
- **Oil and Gas—**Commenters requested that the EIS analysis needs to consider direct, indirect, and cumulative impacts of all aspects of oil and gas exploration and development; examples given are access routes, support facilities, and other infrastructure needed for exploration and development and potential future impacts.
- **Direct/Indirect Impacts—**Commenters requested further definition of the 2,000-acre surface disturbance limit, as defined in the Tax Act, and asked for clarification on what types of surface disturbance would be included and how the 2,000-acre footprint would be measured.
- **Subsistence and Sociocultural Systems—**Commenters noted that local tribes are culturally tied to the Coastal Plain and the Porcupine caribou herd and requested that the EIS analyze impacts from the proposed program on their traditional way of life. They asked that the BLM consider the positive and negative economic changes to communities, impacts on traditional subsistence-based economy, food scarcity, changes to access to traditional subsistence use areas, and subsistence food resources.

Issues outside of the scope of the EIS were also identified during scoping, as follows:

- Comments about land management actions outside of BLM's jurisdiction
- Comments on issues that do not meet the stated purpose and need of the EIS, such as investing in renewable energy alternatives instead of an oil and gas leasing program

1.6 PLANNING PROCESS

The Leasing EIS planning process began with the notice of intent to prepare the Leasing EIS, followed by the formal scoping period (see **Section 1.5**). After the scoping period and after receiving additional input from the public, the BLM consulted with the cooperating agencies and tribes, researched information on the resources and uses of the area, developed a range of reasonable future management alternatives, and analyzed the impacts of those alternatives. These analyses underwent review within the BLM and among the cooperating agencies, resulting in this draft Leasing EIS. This is the second major public step in the planning process.

The public and agencies will be able to comment on this document. Based on these comments and any new studies or information that may come to light after publication of the draft Leasing EIS, the BLM will revise the document and issue a final Leasing EIS. The BLM will not issue its decision on the plan, called the record of decision (ROD), until at least 30 days after publication in the *Federal Register* of the US Environmental Protection Agency's (EPA) notice of the filing of the final EIS.

The list of preparers for the Leasing EIS is in **Appendix B**, Collaboration and Coordination.

1.7 COLLABORATION AND COORDINATION

1.7.1 Lead and Cooperating Agencies

The BLM is the lead agency for this Leasing EIS. The USFWS, EPA, State of Alaska, NSB, Native Village of Venetie Tribal Government, Venetie Village Council, Arctic Village Council, and the Native Village of Kaktovik participate in the Leasing EIS as cooperating agencies. The BLM requested their participation because of their expertise. Their participation does not constitute their approval of the analysis, conclusions, or alternatives presented in this plan; for these, the BLM is solely responsible.

1.7.2 Tribal Coordination and Government-to-Government Consultation

The BLM, as the lead federal agency, coordinated directly with federally recognized tribal governments during preparation of this Leasing EIS. The BLM identified 16 tribal entities potentially affected by the leasing program. Consistent with its policies on government-to-government consultation with tribes, the BLM first sent a letter of notification and inquiry on March 2, 2018, to the Arctic Village Traditional Council, the Inupiat Community of the Arctic Slope, the Native Village of Kaktovik, the Native Village of Venetie, and the Native Village of Venetie Tribal Government. In its letter, the BLM offered these entities the opportunity to participate in formal government-to-government consultation, to participate as cooperating agencies, or to simply receive information about the project.

The BLM sent a second invitation letter on April 23, 2018, to the following tribal entities: Beaver Village Council, Birch Creek Village Council, Chalkyitski Village Council, Gwitchyaa Zhee Gwich'in Tribal Government (Fort Yukon), Naqsragmiut Tribal Council (Anaktuvuk Pass), Native Village of Barrow Iñupiat Traditional Government, Native Village of Fort Yukon, Native Village of Nuiqsut, and the Native Village of Stevens. The dates and locations of government-to-government meetings that have taken place are provided in **Appendix B**. Discussions with potentially affected tribal governments will occur throughout the EIS process.

1.7.3 Coordination and Consultation with Local, State, and Federal Agencies

The BLM also sent a letter of notification and inquiry on March 2, 2018, to Arctic Slope Regional Corporation and Kaktovik Inupiat Corporation, offering the opportunity to participate in formal government-to-government consultation. The BLM has held consultation meetings with both Alaska Native Claims Settlement Act of 1971 (ANCSA) Corporations, as well as Doyon, Limited, to discuss the EIS process (see **Appendix B**).

The BLM is consulting with the Alaska State Historic Preservation Office (SHPO) in accordance with Section 106 of the National Historic Preservation Act of 1966 (NHPA). This is to determine how proposed activities could affect cultural resources listed on or eligible for listing on the National Register of Historic Places (NRHP). Formal consultations with the SHPO also may be required when individual projects are implemented. Consultations with the SHPO are ongoing and will be completed by the time the ROD is signed.

To comply with Section 7(c) of the ESA, the BLM consulted the USFWS early in the EIS process. The USFWS provided input on planning issues, data collection and review, and alternatives development. The BLM will consult with the USFWS to identify ESA issues and to develop the draft biological assessment.

The analysis required by ANILCA Section 810 reached a finding of "X" (see **Appendix C**, ANILCA Section 810 Analysis of Subsistence Impacts). Consequently, the BLM notified the State of Alaska and the North Slope Federal Subsistence Regional Advisory Council of this finding and XX [Note to BLM: this section to be completed prior to DOI Review Team review].

1.8 REQUIREMENTS FOR FURTHER ANALYSIS

The decision on oil and gas leasing resulting from this EIS may authorize multiple lease sales. Any lease sales based on this EIS and associated ROD could begin after the ROD is issued until December 2027. For impact analysis purposes, this Leasing EIS assumes that no fewer than 400,000 acres of land that the ROD determines to be available for leasing would be offered in each lease sale; however, the first sale and subsequent sales might offer only a portion of the lands identified in the ROD as available, making possible a phased approach to leasing and development. The timing of the lease and the lands offered in the subsequent sales would depend in part on the response to the first sale and the results of the exploration that follows. The BLM anticipates that this Leasing EIS will fulfill the NEPA requirements for the first oil and gas lease sales through December 2027.

Future actions requiring BLM approval, including a proposed exploratory drilling plan or proposed construction of infrastructure for a petroleum discovery would require further NEPA analysis. It would be based on specific and detailed information about what kind of activity is proposed and what areas it would affect. Before any oil and gas activity is authorized, the BLM Authorized Officer may require additional site-specific terms and conditions under the authority of 43 Code of Federal Regulations (CFR) 3131.3.

1.9 TREATIES, LAWS, REGULATIONS, AND PERMITS

Implementing the Coastal Plain Oil and Gas Leasing Program would comply with applicable international treaties, federal, state, and local laws, regulations, and executive orders. Secretarial Order 3349, issued on March 29, 2017, directed the DOI to, under Executive Order "Promoting Energy Independence and Economic Growth," (March 28, 2017) to "review all existing regulations, orders, guidance documents, policies, and any other similar actions that potentially burden the development or utilization of domestically produced energy resources." The Secretarial Order in its entirety can be viewed at https://elips.doi.gov/elips/0/doc/4512/Page1.aspx. Secretarial Order 3360, issued on December 22, 2017, rescinded authorities that were found to be inconsistent with Secretarial Order 3349, "American Energy Independence." The Secretarial Order in its entirety can be viewed at https://elips.doi.gov/elips/0/doc/4628/Page1.aspx.

For a summary of other applicable international treaties, federal, state, and local laws, regulations, and executive orders, refer to **Appendix D**, Laws, Regulations, and Permits. The BLM will continue to consult with regulatory agencies, as appropriate, during the NEPA process and before the oil and gas activities begin, to ensure that requirements are met.

Appendix D includes a preliminary list of the permits and approvals that would be required by various agencies before approval of activities, including those for oil and gas exploration or development.

Chapter 2. Alternatives

2.1 INTRODUCTION

The alternatives presented in this draft Leasing EIS address concerns of the public, particularly those comments expressed during the formal scoping period and those raised through consultation with tribes, Native corporations, and cooperating agencies. The range of alternatives presented in this chapter was developed by the BLM's Alaska State Office. The alternatives respond to the need to establish and administer a competitive oil and gas program in the Coastal Plain in the Arctic National Wildlife Refuge (Arctic Refuge).

The alternatives have benefitted from the insights and expertise of the cooperating agencies, though the cooperating agencies are not responsible for the range of alternatives examined in this draft Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS) (see **Section 1.7.1** for a list of the cooperating agencies). The US Department of the Interior, Bureau of Land Management (BLM) as the lead agency, is solely responsible for the alternatives in this draft Leasing EIS.

The alternatives are described in **Section 2.2.2** provides the stipulations and required operating procedures (ROPs) for the action alternatives (Alternatives B, C, and D). Each of the action alternatives contains measures to mitigate or avoid unnecessary surface damage and minimize ecological disturbance throughout the program area.

The BLM is analyzing this range of alternatives to ensure that a wide range of management options are considered, consistent with the law, and that address public scoping suggestions and agency concerns to protect resources. Any decision that the BLM makes following the analysis in this Leasing EIS must be consistent with the Tax Cuts and Jobs Act of 2017, Public Law 115-97 (Tax Act) and with other applicable laws and regulations (see **Section 1.9** and **Appendix D**).

2.2 DESCRIPTION OF THE ALTERNATIVES

Table 2-1 highlights the meaningful differences among alternatives relative to areas available for leasing and stipulations. **Table 2-2** is a complete description of all decisions proposed for each alternative.

Table 2-1
Quantitative Summary of Stipulations by Alternative

	Alternative (Acres)			
	B	**C**	**D1**	**D2**
Not offered for lease sale	**0**	**476,600**	**526,300**	**526,300**
Available for lease sale:				
Subject to no surface occupancy (NSO)	264,100	389,800	708,600	708,600
Subject to controlled surface use (CSU)	0	0	123,900	123,900
Subject to timing limitations (TL)	844,400	350,700	0	204,700
Subject to standard terms and conditions	455,000	346,400	204,700	0
Total available for lease sale	**1,563,500**	**1,086,900**	**1,037,200**	**1,037,200**

Source: BLM GIS 2018

2.2.1 Alternative A—No Action Alternative

Under Alternative A, the No Action Alternative, no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales after the record of decision (ROD) for this EIS has been signed. Alternative A would not include the direction under the Tax Act to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Coastal Plain in the Arctic Refuge. Under this alternative, current management actions would be maintained, and resource trends would continue, as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015).

Alternative A would not meet the purpose of this EIS to inform the BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities; however, Alternative A is being carried forward for analysis to provide a baseline for comparing impacts under the action alternatives.

2.2.2 Alternative B

Alternative B emphasizes oil and gas leasing in the Coastal Plain. The entire Coastal Plain could be offered for lease sale, and there would be the fewest acres with major, moderate, and minor stipulations. The BLM would rely largely on site-specific surveys at the time of development to apply ROPs and design features as conditions of approval (COA). Alternative B is described in **Map 2-1**, Alternative B and **Map 2-2**, Alternative B, Individual Stipulations.

2.2.3 Alternative C

Alternative C balances oil and gas leasing with biological and ecological concerns throughout the Coastal Plain. The BLM would rely on the same ROPs as under Alternative B but would apply more stipulations. Alternative C is described in **Map 2-3**, Alternative C and **Map 2-4**, Alternative C, Individual Stipulations.

2.2.4 Alternative D

Alternative D emphasizes biological and ecological concerns in the Coastal Plain. Portions of it would not be offered for lease sale out of concern for biological end ecological resources. Surface occupancy would also not be permitted in these areas. In some instances, more prescriptive ROPs are analyzed under Alternative D than under Alternatives B and C.

Alternative D contains two sub-alternatives, Alternatives D1 and D2, for the issue of caribou summer habitat. The two sub-alternatives explore other ways to mitigate impacts on caribou summer habitat through minor constraints or required operating ROPs. Alternative D1 is described in **Map 2-5,** Alternative D1 and **Map 2-6**, Alternative D1, Individual Stipulations. Alternative D2 is described in **Map 2-7**, Alternative D2 and **Map 2-8**, Alternative D2, Individual Stipulations.

2.2.5 Stipulations and Required Operating Procedures

Protective measures in Alternatives B, C, and D are of two types—stipulations and ROPs. The stipulations and ROPs are presented in **Table 2-2**.

Stipulations

Appropriate stipulations are attached to the lease before the BLM issues it. As part of a lease contract, stipulations are specific to the lease. All oil and gas activity permits issued to a lessee will comply with

the lease stipulations appropriate to the activity under review, such as exploratory drilling or production pad construction.

A stipulation included in an oil and gas lease would be subject to one of the following:

- A waiver—A permanent exemption to a stipulation on a lease
- An exception—A one-time exemption to a lease stipulation determined on a case-by-case basis
- A modification—A change attached to a lease stipulation, either temporarily or for the life of the lease

A modification would apply to a lease only if the BLM Authorized Officer determines that the factors leading to the stipulation have changed sufficiently to make the stipulation no longer justified; the proposed operation would still have to meet the objective stated for the stipulation.

While the BLM may grant a waiver, exception, or modification of a stipulation through the permitting process, it may also impose additional requirements through permitting terms and conditions to meet the objectives of any stipulation. This would be the case if the BLM Authorized Officer considers such requirements are warranted to protect the land and resources, in accordance with the BLM's responsibility under relevant laws and regulations.

Required Operating Procedures

The ROPs under Alternatives B, C, and D describe the protective measures that the BLM today would impose on applicants during the permitting process. In the context of this draft Leasing EIS, the ROPs also provide a basis for analyzing the potential impacts of the alternatives.

Any applicant requesting authorization for an activity from the BLM will have to address the applicable ROPs in one of the following ways:

- Before submitting the application (e.g., subsistence consultation or surveys)
- As part of the application proposal (e.g., including in the proposal statements that the applicant will meet the objective of the ROP and how the applicant intends to achieve that objective)
- As a term imposed by the BLM in a permit

Requirements that the applicant meets before submitting the application, as well as procedures, practices, and design features that are an integral part of a proposal, would not need to be required as a term of a permit. Note that at the permitting stage, the BLM Authorized Officer would not include those ROPs that, because of their location or other inapplicability, are not relevant to a specific permit application. Note also that at the permit stage, the BLM Authorized Officer may establish additional requirements that would be warranted to protect the land and resources, in accordance with the BLM's responsibility under relevant laws and regulations.

Table 2-2
Stipulations, Required Operating Procedures, and Lease Notice by Alternative

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">Note: While the language below refers only to the BLM or its Authorized Officer, it is understood that all activities, including plan development and consideration of exceptions, modifications, or waivers would include coordination with the US Fish and Wildlife Service (USFWS) as the surface management agency. In addition, the BLM would coordinate with other appropriate federal, state, and North Slope Borough (NSB) agencies and the Native Village of Kaktovik, Native Village of Venetie Tribal Government, the Arctic Village Council, and the Venetie Village Council.</td></tr>
<tr><td colspan="3">PROTECTIONS THAT APPLY IN SELECT BIOLOGICALLY SENSITIVE AREAS</td></tr>
<tr><td colspan="2">Lease Stipulation 1—Rivers and Streams

<u>Objective</u>: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing or over-wintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts on subsistence cabins and campsites; the disruption of subsistence activities and other resource values. Protect the water quality, quantity, and diversity of fish and wildlife habitats and populations associated with springs and aufeis across the Coastal Plain.

<u>Requirement/Standard</u>: (NSO) Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited in the streambed and within the described setback distances outlined below, from the southern boundary of the Coastal Plain to the stream mouth. For streams that are entirely in the Coastal Plain, the setback extends to the head of the stream, as identified in the National Hydrography Dataset. On a case-by case basis, essential pipeline and road crossings to the main channel would be permitted through setback areas. The setbacks may not be practical in river deltas. In these situations, permanent facilities would be designed to withstand a 200-year flood.
a. Canning River: from the western boundary of the Coastal Plain to 1 mile east of the eastern edge of the active floodplain
b. Hulahula River: 1 mile in all directions from the active floodplain
c. Aichilak River: 1 mile from the eastern edge of the Coastal Plain boundary
d. Okpilak River: 1 mile from the banks' ordinary high-water mark
e. Jago River: 1 mile from the banks' ordinary high-water mark
f. The following rivers will have a 0.5-mile setback from the banks' ordinary high-water mark:</td><td>Lease Stipulation 1—Rivers and Streams

<u>Objective</u>: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing or over-wintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts on subsistence cabins and campsites; the disruption of subsistence activities; impacts on wilderness hunting and recreation activities; and impacts on scenic and other resource values. Protect the water quality, quantity, and diversity of fish and wildlife habitats and populations associated with springs and aufeis across the Coastal Plain.

<u>Requirement/Standard</u>: (NSO) Same as Alternative B, with the following rivers and setbacks:
a. Canning River: from the western boundary of the Coastal Plain to 3 miles east of the eastern edge of the active floodplain
b. Hulahula River: 4 miles in all directions from the active floodplain
c. Aichilak River: 3 miles from the eastern edge of the Coastal Plain boundary
d. Okpilak River: 3 miles from the banks' ordinary high-water mark
e. The following rivers will have a 1-mile setback from the banks' ordinary high-water mark:
i. Sadlerochit River
ii. Jago River
f. The following rivers would have a 0.5-mile setback from the banks' ordinary high-water mark:
i. Tamayariak River
ii. Katakturuk River
iii. Nularvik River
iv. Okerokovik River
v. Niguanak River</td></tr>
</table>

Alternative B **Alternative C**	**Alternative D**
i. Sadlerochit River ii. Tamayariak River iii. Okerokovik River	vi. Sikrelurak River vii. Angunwill River viii. Kogotpak River ix. Marsh Creek x. Carter Creek xi. Itkilyariak Creek
Lease Stipulation 2—Canning River Delta and Lakes No similar objective and requirement.	***Lease Stipulation 2—Canning River Delta and Lakes*** Objective: Protect and minimize adverse effects on the water quality, quantity, and diversity of fish and wildlife habitats and populations, subsistence resources, and cultural resources; protect and minimize the disruption of natural flow patterns and changes to water quality, the disruption of natural functions resulting from the loss or change to vegetation and physical characteristics of floodplain and riparian areas; the loss of passage, spawning, rearing or over-wintering habitat for fish; the loss of cultural and paleontological resources; and the loss of migratory bird habitat. Requirement/Standard: (NSO) Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited within 0.5 miles of the ordinary high watermark of any water body in Townships 8 and 9, north of the Canning and Tamyariak watersheds. On a case-by-case basis, essential pipelines, road crossings, and other permanent facilities may be considered through the permitting process in these areas where the lessee/operator/contractor can demonstrate on a site-specific basis that impacts would be minimal.
Lease Stipulation 3—Springs/Aufeis No similar objective or requirement; see Lease Stipulation 1.	***Lease Stipulation 3—Springs/Aufeis*** Objective: Protect the water quality, quantity, and diversity of fish and wildlife habitats and populations associated with springs and aufeis across the Coastal Plain. River systems with springs provide year-round habitat and host the most diverse and largest populations of fish, aquatic invertebrates, and wildlife; they are associated with major subsistence activity and cultural resources. Aufeis is a unique feature associated with perennial springs. It helps sustain river flow during summer and provides insect relief for caribou. Because the subsurface flow paths to perennial springs are unknown and could be disturbed by drilling or fracking, use buffer areas around the major perennial springs that support fish populations in which no leasing is permitted.

Alternative B	Alternative C	Alternative D
		<u>Requirement/Standard:</u> a. Before drilling, the lessee/operator/permittee would conduct studies in areas containing springs to ensure subsequent drilling activities would not disrupt flow of the perennial springs, unless such studies have already been completed. Study plans would be developed in consultation with the BLM and USFWS and other agencies, as appropriate. b. The following areas would **not be offered for lease sale and NSO** would be permitted: i. Within 3 miles of or above Sadlerochit Spring and within a 1-mile buffer below the spring where it enters the Saddlerochit River and along the aufeis formation. This spring supports an isolated, dwarf population of Dolly Varden, unique plant and invertebrate communities, and an extensive aufeis field that persists through much of the summer, providing insect relief habitat for caribou. ii. Within 3 miles of or above the perennial spring at Fish Hole 1 on the Hulahula River. Further, no new infrastructure within 4 miles of the perennial spring at Fish Hole 1 on the Hulahula River nor within 1 mile of the aufeis field. The Fish Hole 1 spring provides overwintering habitat for Arctic grayling and a large population of anadromous Dolly Varden. Residents of Kaktovik routinely harvest Dolly Varden in Fish Hole 1 during winter. The spring produces an extensive aufeis field that persists through much of the summer. iii. Within 3 miles of or above the perennial Tamayariak Spring, and no new non-subsistence infrastructure would be permitted within 1 mile of the associated aufeis field. c. NSO within 3 miles of the eastern bank of the Canning River, including through the delta. The Canning River is the largest river crossing the Coastal Plain. It has several perennial springs originating upstream from the Coastal Plain that provide steady flow under ice across the Coastal Plain. The river supports several fish species, including Arctic grayling and a large population of anadromous Dolly Varden. Aufeis fills the river corridor across the Coastal Plain and extends well into the delta, providing insect relief to Caribou during the early summer.
Lease Stipulation 4—Nearshore marine, lagoon, and barrier island habitats of the Southern Beaufort Sea, within the boundary of the Arctic Refuge No similar objective or requirement.		***Lease Stipulation 4—Nearshore marine, lagoon and barrier island habitats of the Southern Beaufort Sea within the boundary of the Arctic Refuge*** <u>Objective:</u> Protect fish and wildlife habitat, including that for waterfowl and shorebirds, caribou insect-relief, marine mammals, and polar bear summer and winter coastal habitat; preserve air and water quality; and minimize impacts on

Alternative B	Alternative C	Alternative D
		subsistence activities, recreation, historic travel routes, and cultural resources on the major coastal water bodies. <u>Requirement/Standard</u> Exploration: (TL) Oil and gas exploration operations, such as drilling, seismic exploration, and testing, are not allowed on the major coastal water bodies and coastal islands between May 15 and November 1 or when sea ice is within 10 miles of the coast of each season, whichever is later. Requests for approval of any activities must be submitted in advance and must be accompanied by evidence and documentation that demonstrates to the satisfaction of the BLM Authorized Officer that the actions or activities meet all of the following criteria: a. Exploration would not unreasonably conflict with subsistence uses or significantly affect seasonally concentrated fish and wildlife resources. The location of exploration and related activities would be sited to not pose a hazard to navigation by the public using high-use, subsistence-related travel routes into and through the major coastal waterbodies, as identified by the NSB and the Native Village of Kaktovik, recognizing that marine and nearshore travel routes change over time and are subject to shifting environmental conditions. b. Avoid or minimize impacts related to oil spill response activities, including vessel, aircraft, and pedestrian traffic to minimize additional impacts or further compound direct spill-related impacts on area resources and subsistence uses.
Lease Stipulation 5—Coastal Polar Bear Denning River Habitat No similar objective or requirement.		***Lease Stipulation 5—Coastal Polar Bear Denning River Habitat*** <u>Objective:</u> Minimize disturbance to denning polar bears, and disturbance or alteration of key river and creek maternal denning habitat areas. <u>Standard:</u> a. NSO: From the coastline to 5 miles inland, no permanent oil and gas infrastructure would be within 1 mile of potential polar bear denning habitat on the Niguanak River, Katakturuk Creek, Marsh Creek, Carter Creek, and Saddlerochit River, unless the BLM Authorized Officer approves alternative protective measures. This area encompasses approximately **105,400** acres. b. TL: From the coastline to 5 miles inland, between October 30 and April 15 of any year, the lessee/operator/contractor would not conduct oil and gas activities within 1 mile of potential polar bear denning habitat on the Niguanak River, Katakturuk Creek, Marsh Creek, Carter Creek, and Saddlerochit River, unless the BLM Authorized Officer approves alternative protective measures.

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th colspan="2">Alternative D</th></tr>
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<td colspan="2">
Required Operating Procedure—Caribou Summer Habitat
Note: All lands in the Arctic Refuge Coastal Plain are recognized as habitat of the Porcupine and Central Arctic caribou herds and would be managed to ensure unhindered movement of caribou through the area.

<u>Objective:</u> Minimize disturbance and hindrance of caribou or alteration of caribou movements through portions the Coastal Plain that are essential for calving and rearing summer use by caribou.

<u>ROP:</u> The following standards would be applied to permitted activities:
a. When laying out oil and gas field developments, lessees would orient infrastructure to avoid impeding caribou migration and to avoid corralling effects.
b. Before the construction of permanent facilities is authorized (limited as they may be by restricted surface occupancy areas established in other lease stipulations), the lessee would design and implement and report a study of caribou movement, unless an acceptable study specific to the Porcupine and Central Arctic Caribou herds has been completed within the last 10 years.
c. A plan to minimize vehicle impacts on caribou during calving and rearing periods, with traffic management following industry standards would be developed by the lessee/operator/contractor and approved by the BLM Authorized Officer, in consultation with the appropriate federal, state, and NSB regulatory and resource agencies. The lessee/operator/contractor would observe caribou movement from May 20 through June 20, or earlier if caribou are present before May 20. Based on these observations, traffic would be stopped temporarily to allow a crossing by 10 or more caribou. Sections of road would be evacuated whenever an attempted crossing by a large number of caribou (approximately 100 or more) appears to be imminent. The lessee/operator/contractor would submit with the development proposal a vehicle use plan that considers these and any other mitigation.
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<td>
ALTERNATIVE D-1
Lease Stipulation 6—Caribou Summer Habitat

Same as Alternatives B and C.
</td>
<td>
ALTERNATIVE D-2
Lease Stipulation 6—Caribou Summer Habitat

Note: All lands in the Arctic Refuge Coastal Plain are recognized as habitat of the Porcupine and Central Arctic caribou herds and would be managed to ensure unhindered movement of caribou through the area.

<u>Objective:</u> Minimize disturbance and hindrance of caribou or alteration of caribou movements through portions of the Coastal Plain that are essential for summer use by caribou, including calving and rearing, insect-relief, and migration.

<u>ROP:</u> The following standards would be applied to permitted activities:
a. When laying out oil and gas field developments, lessees would orient infrastructure to avoid impeding caribou migration and to avoid corralling effects.
b. Before the construction of permanent facilities is authorized (limited as they may be by restricted surface occupancy areas established in other lease stipulations), the lessee would design and implement and report a study of caribou movement, unless an acceptable study specific to the Porcupine and Central Arctic Caribou herds has been completed within the last 10 years.
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</tr>
</table>

Alternative B	Alternative C	Alternative D	
			Stipulation: (TL) Heavy equipment, such as for sand and gravel extraction and transport, pipeline and pad construction, but not drilling from existing production pads, would be suspended from no later than May 20 through no earlier than July 20, unless approved by the BLM Authorized Officer, in consultation with the appropriate federal, state, and NSB regulatory and resource agencies. The intent of this requirement and allowance for deviation is to restrict activities that would disturb caribou during calving and insect-relief periods but allow for activity if caribou are unlikely to be disturbed in significant numbers. If caribou arrive on the calving grounds before May 20, or if they remain in the area past July 20 in significant numbers (greater than approximately 10% of the estimated calving cow population or 1,000 during insect-relief periods), major construction would be suspended. The lessee would submit with the development proposal a stop work plan that considers this and any other mitigation related to caribou early arrival or late departure. The intent of this requirement is to provide flexibility to adapt to changing climate conditions that may occur during the life of oilfields in the region. The following ground and air traffic restrictions would apply in the areas and during the periods indicated. Ground traffic restrictions apply to

Alternative B	Alternative C	Alternative D	
			permanent oil and gas-related roads: a. From May 20 through July 20, traffic speed would not exceed 15 miles per hour when caribou are within 0.5 miles of the road. Additional strategies may include limiting trips, using convoys, and using different vehicle types to the extent practicable. The lessee would submit with the development proposal a vehicle use plan that considers these and any other mitigation. The vehicle use plan would also include a vehicle-use monitoring plan. The BLM Authorized Officer would require adjustments if she or he determines the resulting disturbance to be unacceptable. b. The lessee/operator/contractor would observe caribou movement from May 20 through July 20, or earlier than May 20 if caribou are present. Based on these observations, traffic would be stopped in the following manner: i. Temporarily to allow a crossing by 10 or more caribou. Sections of road would be evacuated whenever an attempted crossing by a large number of caribou (approximately 100 or more) appears to be imminent. The lessee/operator/contractor would submit with the development proposal a vehicle use plan that considers these and any other mitigations. ii. By direction of the BLM

Alternative B	Alternative C	Alternative D	
			Authorized Officer throughout a defined area for up to 4 weeks, to prevent displacement of calving caribou. The vehicle use plan would also include a vehicle-use monitoring plan. The BLM Authorized Officer would require adjustments if he or she determines that the resulting disturbance is unacceptable. c. Major equipment, materials, and supplies to be used at oil and gas work sites would be stockpiled before or after the period of May 20 through July 20 to minimize road traffic. d. Aircraft use would be restricted in areas where caribou are present from May 20 through July 20, unless doing so would endanger human life or violate safe flying practices. The lessee/operator/contractor would submit with the development proposal an aircraft use plan that considers these and other mitigations. The aircraft use plan would also include an aircraft monitoring plan. The BLM Authorized Officer would require adjustments, including perhaps suspending all aircraft use, if she or he determines the resulting disturbance to be unacceptable. This lease stipulation is not intended to restrict wildlife survey flights for information necessary to meet the stated objective of the stipulations; however, flights necessary to gain this information

Alternative B	Alternative C	Alternative D
		would be restricted to the minimum necessary to collect such data. Aircraft pilots would maintain a minimum height of 1,000 feet above ground level (AGL), except for takeoffs and landings, from May 20 through July 20, unless doing so would endanger human life or violate safe flying practices.
Lease Stipulation 7—Porcupine Caribou Calving Habitat Area <u>Objective:</u> Minimize disturbance and hindrance of caribou or alteration of their movements in the south-southeast portion of the Coastal Plain, which has been identified as important caribou habitat during calving, post-calving, and insect relief periods. <u>Requirement/Standard:</u> (TL) The Porcupine Caribou primary calving area is defined as the area with a higher-than-average density of cows about to give birth during more than 40% of the year. Human activity would be limited when caribou are present (generally May 15 to June 15). These areas encompass approximately **721,200** acres.	***Lease Stipulation 7—Porcupine Caribou Calving Habitat Area*** <u>Objective:</u> Minimize disturbance and hindrance of caribou or alteration of their movements in the south-southeast portion of the Coastal Plain, which has been identified as important caribou habitat during calving, post-calving, and insect relief periods. <u>Requirement/Standard:</u> The Porcupine caribou herd's primary calving area is defined as that with higher-than-average density of caribou cows about to give birth during more than 40% of the year. a. Approximately 476,600 acres would not be offered for lease and would not be available for surface occupancy.	***Lease Stipulation 7—Porcupine Caribou Calving Habitat Area*** <u>Objective:</u> Minimize disturbance and hindrance of caribou or alteration of their movements in the south-southeast portion of the Coastal Plain, which has been identified as important caribou habitat during calving, post-calving, and insect relief periods. <u>Requirement/Standard:</u> The Porcupine caribou herd's primary calving area is defined as the area with higher-than-average density of caribou cows about to give birth during more than 40% of the year. a. Approximately 476,600 acres would not be offered for lease and would not be available for surface occupancy. b. Approximately 244,600 acres may be offered for lease but subject to NSO.

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<tr><th>Alternative B</th><th>Alternative C</th><th colspan="2">Alternative D</th></tr>
<tr><td></td><td>b. Approximately 129,600 acres may be offered for lease but subject to NSO.
c. Approximately 115,000 acres may be offered for lease but subject to a timing limitation. Human activity would be limited when caribou are present (generally May 15–June 15).</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Lease Stipulation 8—Porcupine Caribou Post-Calving Habitat Area

<u>Objective:</u> To protect key surface resources and subsistence resources/activities resulting from permanent oil and gas development and associated activities in areas used by caribou during calving, post-calving, and insect-relief periods.

<u>Requirement/Standard:</u> (TL) The Porcupine caribou post-calving habitat area includes areas used for group formation and insect relief during late June and early July. Human activity would be limited when caribou are present (generally June 15–July 30). This area encompasses approximately 264,300 acres.</td><td rowspan="2">Lease Stipulation 8—Porcupine Caribou Post-Calving Habitat Area

<u>Objective:</u> To protect key surface resources and subsistence resources and activities resulting from permanent oil and gas development and associated activities in areas used by caribou during calving, post-calving, and insect-relief periods.

<u>Requirement/Standard:</u> (TL) The Porcupine caribou post-calving habitat area includes areas used for group formation and insect relief during late June and early July. Human activity would be limited when caribou are present (generally June 15–July 30). This area encompasses approximately 264,300 acres.</td><td colspan="2">Lease Stipulation 8a—Porcupine Caribou Post-Calving Habitat Area

<u>Objective:</u> To protect key surface resources and subsistence resources/activities resulting from permanent oil and gas development and associated activities in areas used by caribou during calving, post-calving, and insect-relief periods.

<u>Requirement/Standard:</u> Development CSU: No central processing facilities would be allowed in the Porcupine caribou post-calving habitat area. Well pads, roads, airstrips, and pipelines would be permitted, in accordance with Stipulation 6, Caribou Summer Habitat. This area encompasses approximately 264,300 acres. Infrastructure would be limited across the area to 100 acres per township, not to exceed 510 acres total in this area.</td></tr>
<tr><td>ALTERNATIVE D-1

Lease Stipulation 8b—Porcupine Caribou Post-Calving Habitat Area

<u>Objective:</u> To protect key surface resources and subsistence resources/activities resulting from permanent oil and gas development and associated activities in areas used by caribou during calving, post-calving, and insect-relief periods.

<u>Requirement/Standard:</u> (TL) The Porcupine caribou post-calving habitat area includes areas used for group</td><td>ALTERNATIVE D-2

Lease Stipulation 8b—Porcupine Caribou Post-Calving Habitat Area

No similar TL needed due to Lease Stipulation 6.</td></tr>
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Alternative B	Alternative C	Alternative D	
		formation and insect relief during late June and early July. Human activity would be limited when caribou are present (generally June 15–July 30). This area encompasses approximately 264,300 acres.	
Lease Stipulation 9—Coastal Area Objective: Protect coastal waters, lagoons, barrier islands, shorelines, and their value as fish and wildlife habitat (including for waterfowl, shorebirds, and marine mammals); minimize the hindrance or alteration of caribou movement in caribou coastal insect-relief areas; minimize hindrance or alteration of polar bear utilization and movement in coastal habitats; protect and minimize disturbance from oil and gas activities to coastal habitats for polar bears and seals; prevent loss and alteration of important coastal bird habitat; and prevent impacts on coastal subsistence resources and activities. ROP: Before beginning exploration or development, lessees/operators/contractors would be required to conduct a coastline survey between the northern boundary of the Arctic Refuge and the mainland and in inland areas within 2 miles of the coast. Based on the survey, the lessee/operator/contractor would develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on these coastal habitats and their use by wildlife	***Lease Stipulation 9—Coastal Area*** Objective: Protect coastal waters, lagoons, barrier islands, and shorelines and their value as fish and wildlife habitat (including for waterfowl, shorebirds, and marine mammals); minimize the hindrance or alteration of caribou movement in caribou coastal insect-relief areas; minimize the hindrance or alteration of polar bear utilization and movement in coastal habitats; protect and minimize disturbance from oil and gas activities to coastal habitats for polar bears and seals; prevent loss and alteration of important coastal bird habitat; and prevent impacts on coastal area subsistence resources and activities. Requirement/Standard: (NSO) Exploratory well drill pads, production well drill pads, or central processing facilities for oil and gas are not allowed in coastal waters,	***Lease Stipulation 9—Coastal Area*** Objective: Protect coastal waters, lagoons, barrier islands, shorelines, and their value as fish and wildlife habitat (including for waterfowl, shorebirds, and marine mammals); minimize the hindrance or alteration of caribou movement in caribou coastal insect-relief areas; minimize hindrance or alteration of polar bear utilization and movement in coastal habitats; protect and minimize disturbance from oil and gas activities to coastal habitats for polar bears and seals; prevent loss and alteration of important coastal bird habitat; and prevent impacts on coastal subsistence resources and activities. Requirement/Standard: a. NSO: Exploratory well drill pads, production well drill pads, or a central processing facility for oil or gas would not be permitted within coastal waters, lagoons, or barrier islands within the boundaries of the Arctic Refuge Coastal Plain area or 2 miles inland of the coast. Other facilities necessary for oil and gas production that necessarily must be in this area, such as barge landing, seawater treatment plant, or spill response staging and storage areas, would not be prevented, nor would this stipulation prevent infrastructure associated with offshore oil and gas exploration and production or construction and renovation. b. Oil and gas operations are not allowed on the major coastal water bodies and coastal islands between May 15 and until November 1 or sea ice is within 10 miles of the coast of each season, whichever is later. Requests for approval of any activities must be submitted in advance and must be accompanied by evidence and documentation that demonstrates to the satisfaction of the BLM Authorized Officer and the USFWS that the actions or activities meet all the following criteria: i. Exploration activities would not unreasonably conflict with subsistence uses or significantly affect seasonally concentrated fish and wildlife resources. ii. There would be adequate spill response capability to effectively respond during periods of broken ice or open water, or the availability of	

Alternative B	Alternative C	Alternative D
and people.	lagoons, or barrier islands within the boundaries of the Arctic Refuge Coastal Plain area or 1 mile inland of the coast. The BLM Authorized Officer may approve infrastructure necessary for oil and gas activities in these critical and sensitive coastal habitats, such as barge landing, docks, spill response staging and storage areas, or pipelines. Approval would be on a case-by-case basis, in consultation with the USFWS, or the National Oceanographic and Atmospheric Administration (NOAA), or both, as appropriate. All lessees/operators/contractors involved in authorized activities in the coastal area must coordinate construction and use infrastructure with all other prospective Arctic Refuge users or user groups. Before conducting open water activities, the lessee/operator/contractor would consult with the Alaska Eskimo Whaling Commission, the NSB, and local whaling captains' associations to minimize impacts on subsistence whaling and other subsistence activities of the communities of the North Slope. Where the BLM	alternative methods to prevent well blowouts or pipeline leaks when adequate response capability cannot be demonstrated. Such alternative methods may include improvements in blowout prevention technology, equipment, or changes in operational procedures and top-setting hydrocarbon-bearing zones. iii. Oil spill response, including vessel, aircraft, and pedestrian traffic, would be conducted to minimize additional impacts or further compounding of direct spill-related impacts on area resources and subsistence uses. iv. The location of exploration and related activities would be sited to not pose a hazard to navigation by the public. This is when they are using high-use subsistence-related travel routes into and through the major coastal waterbodies, as identified by the NSB and the Native Village of Kaktovik. Lessees/operators/contractors would recognize that marine and nearshore travel routes change over time, subject to shifting environmental conditions. c. The BLM Authorized Officer may approve infrastructure necessary for oil and gas activities in these critical and sensitive coastal habitats, such as barge landing, docks, spill response staging and storage areas, or pipelines. Approval would be on a case-by-case basis, in consultation with USFWS, or NOAA, or both, as appropriate. All lessees/operators/contractors involved in authorized activities in the coastal area must coordinate construction and use infrastructure with all other prospective Arctic Refuge users or user groups. Before conducting open water activities, the lessee/operator/contractor would consult with the Alaska Eskimo Whaling Commission, the NSB, and local whaling captains' associations to minimize impacts on subsistence whaling and other subsistence activities of the communities of the North Slope. In a case in which the BLM authorizes permanent oil and gas infrastructure in the coastal area, the lessee/operator/contractor would develop and implement an impact and conflict avoidance and monitoring plan. This would be used to assess, minimize, and mitigate the effects of the infrastructure and its use on these Coastal Area habitats and their use by wildlife and people, including the following: i. Design and construction of facilities would minimize impacts on subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources. ii. Daily operations, including use of support vehicles, watercraft, and aircraft traffic, alone or in combination with other past, present, and reasonably foreseeable activities, would be conducted to minimize impacts on subsistence uses, travel corridors, and seasonally concentrated fish and

Alternative B	Alternative C	Alternative D
	authorizes permanent oil and gas infrastructure in the coastal area, the lessee/operator/contractor would develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on these coastal habitats and their use by wildlife and people.	wildlife resources. iii. The location of oil and gas facilities, including artificial islands, platforms, associated pipelines, ice or other roads, bridges or causeways, would be sited and constructed so as to not pose a hazard to public navigation, using traditional high-use subsistence-related travel routes into and through the major coastal lagoons and bays, as identified by the community of Kaktovik and the NSB. iv. Demonstrate year-round oil spill response capability, including the capability of adequate response during periods of broken ice or open water, or the availability of alternative methods to prevent well blowouts when adequate response capability cannot be demonstrated. Such alternative methods may include seasonal drilling restrictions, improvements in blowout prevention technology, equipment or changes in operational procedures, and top-setting hydrocarbon-bearing zones. d. Avoid or minimize impacts from oil spill responses, including vessel, aircraft, and pedestrian traffic that add to impacts or further compound direct spill-related impacts on area resources and subsistence uses. Before conducting open water activities, the lessee/operator/contractor would consult with the community of Kaktovik, the Alaska Eskimo Whaling Commission, and the NSB to minimize impacts on the fall and spring subsistence whaling activities of the communities of the North Slope. e. Vessels used as part of a BLM-authorized activity would be operated in a manner that minimizes disturbance to wildlife in the Coastal Area. Vessels would maintain a 1-mile buffer from the shore when transiting past an aggregation of seals (primarily spotted seals) when they have hauled out on land, unless doing so would endanger human life or violate safe boating practices. Vessel operators would maintain a 0.5-mile buffer from polar bears on land or ice and would avoid polar bears in the water by at least 100 yards, unless doing so would endanger human life or violate safe boating practices. Vessel crews would not conduct ballast transfers or discharge any matter into the marine environment within 3 miles of the coast, except when necessary for the safe operation of the vessel.
Lease Stipulation 10—Wilderness Boundary No similar objective or requirement.		***Lease Stipulation 10—Wilderness Boundary*** <u>Objective:</u> Protect wilderness values in the Mollie Beattie Wilderness Area. <u>Requirement/Standard:</u> a. NSO: Surface occupancy, including exploratory and production well drill pads, structures and facilities, and gravel and ice roads, would not be allowed within

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="2"></td><td>3 miles of the southern and eastern boundaries of the Coastal Plain where they are near designated wilderness.
b. To the extent practicable, aircraft operations would be planned to minimize flights below 2,000 feet when flying within 3 miles of a wilderness boundary.</td></tr>
<tr><td colspan="3">Lease Stipulation 11—Traditional/Subsistence Access Routes

Objective: Prevent disruption of subsistence use and access.

Requirement/Standard: Before starting exploration or development, lessees/operators/contractors are required to develop a subsistence access plan, in coordination with the Native Village of Kaktovik and the City of Kaktovik, to be approved by the BLM Authorized Officer.</td></tr>
<tr><td colspan="3">WASTE PREVENTION, HANDLING, DISPOSAL, SPILLS, AND PUBLIC SAFETY</td></tr>
<tr><td colspan="3">Required Operating Procedure 1

Objective: Protect the health and safety of oil and gas field workers and the general public by disposing of solid waste and garbage, in accordance with applicable federal, state, and local laws and regulations.

Requirement/Standard: Areas of operation would be left clean of all debris.</td></tr>
<tr><td colspan="2">Required Operating Procedure 2

Objective: Minimize impacts on the environment from nonhazardous and hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil and gas field workers and the general public. Minimize human-caused changes in predator populations.

Requirement/Standard: The lessee/operator/contractor would prepare and implement a comprehensive waste management plan for all phases of exploration and development, including seismic activities. The plan would be submitted to the BLM Authorized Officer for approval, in consultation with federal, state, and NSB regulatory and resource agencies, as appropriate (based on agency legal authority and jurisdictional responsibility), as part of a plan of operations or other similar permit application.</td><td>Required Operating Procedure 2

Objective: Minimize impacts on the environment from nonhazardous and hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil and gas field workers, local communities, Arctic Refuge subsistence users, Arctic Refuge recreationists, and the general public. Minimize human-caused changes in predator populations. Minimize attracting predators, particularly bears, to human use areas.

Requirement/Standard: Lessees/operators/permittees would prepare and implement a comprehensive waste management plan for all phases of exploration, development and production, including seismic activities. The plan would include methods and procedures to use bear resistant containers for all waste materials and classes. The plan would be submitted to the BLM Authorized Officer and the USFWS for approval, in consultation with other federal, state, and NSB regulatory and resource agencies, as appropriate (based on agency legal authority and jurisdictional responsibility), as part of a plan of operations or other similar permit application. Management decisions affecting waste generation would be addressed in the following order of priority: (1) prevention and reduction, (2) recycling, (3) treatment, and (4) disposal. The planners would consider and take into account the following requirements:
a. Methods to avoid attracting wildlife to food and garbage. The plan would</td></tr>
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Alternative B	Alternative C	Alternative D
		identify precautions that are to be taken to avoid attracting wildlife to food and garbage. The use of bear resistant containers for all waste would be specified. b. <u>Disposal of rotting waste</u>. Requirements prohibit burying garbage. Lessees and permitted users would have a written procedure to ensure that rotting waste would be handled and disposed of in a manner that prevents the attraction of wildlife. The use of bear resistant containers for all waste would be required. All rotting waste would be incinerated, backhauled, or composted in a manner approved by the BLM Authorized Officer and the USFWS. All solid waste, including incinerator ash, would be disposed of in an approved waste-disposal facility, in accordance with EPA and Alaska Department of Environmental Conservation (DEC) regulations and procedures. Burying human waste is prohibited, except as authorized by the BLM Authorized Officer. c. <u>Disposal of pumpable waste products</u>. Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by injection, in accordance with EPA, Alaska DEC, and the Alaska Oil and Gas Conservation Commission regulations and procedures. On-pad temporary muds and cuttings storage, as approved by Alaska DEC, would be allowed as necessary to facilitate annular injection and backhaul operations. d. Disposal of wastewater and domestic wastewater. The BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by a National Pollutant Discharge Elimination System (NPDES) or state permit.
Required Operating Procedure 3 Management decisions affecting waste generation would be addressed in the following order of priority: (1) prevention and reduction, (2) recycling, (3) treatment, and (4) disposal. The plan would consider and take into account the following requirements: a. <u>Methods to avoid attracting wildlife to food and garbage</u>. The plan would identify precautions that are to be taken to avoid attracting wildlife to food and garbage. b. <u>Disposal of rotting waste</u>. Requirements prohibit burying garbage. Lessees/operators/contractors would have a written procedure to ensure that rotting waste would be handled and disposed of in a manner that prevents the attraction of wildlife. All rotting waste would be incinerated, backhauled, or composted in a manner approved by the BLM Authorized Officer. All solid waste, including incinerator ash,		***Required Operating Procedure 3*** For oil- and gas-related activities, a hazardous materials emergency contingency plan would be prepared and implemented before transporting, storing, or using fuel or hazardous substances. The plan would include a set of procedures to ensure prompt response, notification, and cleanup in the event of a hazardous substance spill or threat of a release. Procedures in the plan applicable to fuel and hazardous substances handling (associated with transportation vehicles) would consist of best management practices if approved by the BLM Authorized Officer. The plan would include a list of resources available for response, such as heavy-equipment operators and spill-cleanup materials or companies, and names and phone numbers of federal, state, and NSB contacts. Other federal and state regulations may apply and require additional planning requirements. All appropriate staff would be instructed regarding these procedures.

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<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="2">would be disposed of in an approved waste-disposal facility, in accordance with EPA and Alaska DEC regulations and procedures. Burying human waste is prohibited, except as authorized by the BLM Authorized Officer.
c. <u>Disposal of pumpable waste products</u>. Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by injection, in accordance with EPA, Alaska DEC, and the Alaska Oil and Gas Conservation Commission regulations and procedures. On-pad temporary muds and cuttings storage, as approved by Alaska DEC, would be allowed as necessary to facilitate annular injection and backhaul operations.
d. <u>Disposal of wastewater and domestic wastewater</u>. The BLM prohibits wastewater discharges or disposal of domestic wastewater int bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by a NPDES or State permit.</td><td>In addition, contingency plans related to facilities developed for oil production would include requirements to accomplish the following:
a. Provide refresher spill-response training to NSB and local community spill-response teams annually
b. Plan and conduct a major spill-response field-deployment drill annually
c. Before production and as required by law, develop spill prevention and response contingency plans and participate in development and maintenance of the North Slope Subarea Contingency Plan for Oil and Hazardous Substances Discharges/Releases for the Arctic National Wildlife Refuge. Planning would include developing and funding detailed (1:26,000 scale) environmental sensitivity index maps for the lessee's/permittee's operating area and areas outside the lessee's/permittee's operating area that could be affected by their activities. The specific area to be mapped would be defined in the lease agreement and approved by the BLM Authorized Officer. Maps would be completed in paper copy and geographic information system (GIS) format in conformance with the latest version of the US Department of Commerce, NOAA's Environmental Sensitivity Index Guidelines. Draft and final products would be peer reviewed and approved by the BLM Authorized Officer.</td></tr>
<tr><td colspan="2">Required Operating Procedure 4

<u>Objective</u>: Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment.

<u>Requirement/Standard</u>: Refueling equipment within 100 feet of the active floodplain of any water body is prohibited. Fuel storage stations would be located at least 100 feet from any water body except for small caches (up to 210 gallons) for motor boats, float planes, ski planes, and small equipment, such as portable generators and water pumps. The BLM Authorized Officer may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions.</td><td>Required Operating Procedure 4

<u>Objective</u>: Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment.

<u>Requirement/Standard</u>: Refueling of equipment within 500 feet of the active floodplain of any water body is prohibited. Fuel storage stations would be located at least 500 feet from any water body, except for small caches (up to 210 gallons) for motor boats, float planes, ski planes, and small equipment, such as portable generators and water pumps. The BLM Authorized Officer may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions.</td></tr>
<tr><td colspan="3">Required Operating Procedure 5

<u>Objective</u>: Minimize conflicts resulting from interaction between humans and bears during oil and gas activities.

<u>Requirement/Standard</u>: The lessee/operator/contractor, as a part of lease operation planning, would prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These bear interaction plans would be developed in consultation with and approved by the USFWS and the Alaska Department of Fish and Game. The plans would include specific measures identified in the current USFWS Polar Bear Mitigation Plan and would be adapted as needed for grizzly bears.</td></tr>
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<tr><th>Alternative B Alternative C</th><th>Alternative D</th></tr>
<tr><td>Required Operating Procedure 6

<u>Objective</u>: Reduce air quality impacts.

<u>Requirement/Standard</u>: All oil and gas operations (vehicles and equipment) that burn diesel fuels must use ultra-low sulfur diesel, as defined by the Alaska DEC, Division of Air Quality.</td><td>Required Operating Procedure 6

<u>Objective</u>: Reduce air quality impacts.

<u>Requirement/Standard</u>: All oil and gas operations (vehicles and equipment) that burn diesel fuels must use ultra-low sulfur diesel, as defined by the Alaska DEC, Division of Air Quality.

To the extent practicable, all oil and gas operations (vehicles and equipment) must be powered by natural gas or electric power, rather than diesel fuel. To the extent natural gas and electric power are not practicable, the permittee would use gasoline rather than diesel to the extent practicable. Any vehicles and equipment that require diesel fuel must use ultra-low sulfur diesel, as defined by the Alaska DEC, Division of Air Quality.</td></tr>
<tr><td colspan="2">Required Operating Procedure 7

<u>Objective</u>: Prevent unnecessary or undue degradation of the lands and protect health.

<u>Requirement/Standard</u>: This measure includes the following elements:
a. Before NEPA analysis begins for an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential air pollutant emission source (hereafter project), the BLM Authorized Officer may require the project proponent to provide a minimum of 1 year of baseline ambient air monitoring data for any pollutant of concern, as determined by the BLM. This would go into effect if no representative air monitoring data are available for the project area, or existing representative ambient air monitoring data are insufficient, incomplete, or do not meet minimum air monitoring standards set by the Alaska DEC or the EPA. If the BLM determines that baseline monitoring is required, this pre-analysis data must meet Alaska DEC and EPA air monitoring standards and cover the year before the submittal. Pre-project monitoring may not be appropriate where the life of the project is less than 1 year.
b. The BLM may require monitoring for the life of the project, depending on the magnitude of potential air emissions from the project, proximity to a federally mandated Class I area, sensitive Class II area (as identified on a case-by-case basis by Alaska DEC or a federal land management agency), or population center, a location in or near a nonattainment or maintenance area, under meteorological or geographic conditions, existing air quality conditions, magnitude of existing development in the area, or issues identified during NEPA analysis for the project.
c. For an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the project proponent would submit for BLM approval an emissions inventory that includes quantified emissions of regulated air pollutants from all direct and indirect sources related to the proposed project, including reasonably foreseeable air pollutant emissions of criteria air pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases estimated for each year for the life of the project. The BLM would use this estimated emissions inventory to identify pollutants of concern and to determine the appropriate level of air analysis to be conducted for the proposed project.
d. For an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the BLM may require the proponent to provide an emissions reduction plan that includes a detailed description of operator-committed measures to reduce project related air pollutant emissions, including greenhouse gases and fugitive dust.</td></tr>
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Alternative B	Alternative C	Alternative D

e. For an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the BLM Authorized Officer may require air quality modeling for analyzing project direct, indirect, or cumulative impacts on air quality. The BLM may require air quality modeling, depending on the magnitude of potential air emissions from the project or activity, the duration of the proposed action, the proximity to a federally mandated Class I area, sensitive Class II area (as identified by Alaska DEC or a federal land management agency), population center, location in a nonattainment or maintenance area, one with meteorological or geographic conditions, existing air quality conditions, magnitude of existing development in the area, or issues identified during NEPA analysis for the project. The BLM would determine the information required for a project-specific modeling analysis by developing a modeling protocol for each analysis. The BLM Authorized Officer would consult with appropriate federal, state, or local agencies regarding modeling to inform his or her modeling decision and avoid duplication of effort. The modeling would compare predicted impacts on all applicable local, State, and federal air quality standards and increments, as well as other scientifically defensible significance thresholds, such as impacts on air quality-related values (AQRVs) and incremental cancer risks.

f. The BLM may require air quality mitigation measures and strategies within its authority (and in consultation with local, state, federal, and tribal agencies with responsibility for managing air resources) in addition to regulatory requirements and proponent committed emission reduction measures and for emission sources not otherwise regulated by Alaska DEC or EPA. This would be the case if the air quality analysis were to show potential future impacts on National Ambient Air Quality Standards (NAAQS) or Alaska Ambient Air Quality Standards (AAAQS) or impacts above specific levels of concern for AQRVs.

g. If ambient air monitoring indicates that project-related emissions are causing or contributing to impacts that would cause unnecessary or undue degradation of the lands, cause exceedances of NAAQS, or fail to protect health (either directly or through use of subsistence resources), the BLM Authorized Officer may require changes in activities at any time to reduce these emissions, to comply with the NAAQS or minimize impacts on AQRVs. Within the scope of its authority, the BLM may require additional emission control strategies to minimize or reduce impacts on air quality.

h. Publicly available reports on air quality baseline monitoring, emissions inventory, and modeling results developed in conformance with this ROP would be provided by the project proponent to the NSB and to local communities and tribes in a timely manner.

Objective: Provide BLM oversight and technical review of air quality monitoring near the Greater Mooses Tooth Unit 1 project; address concerns in the local community regarding oversight for air quality.

a. Requirement/Standard: The permittee would provide funding for monitoring to identify and address air quality concerns in the Nuiqsut area. Reports from the monitoring station in Nuiqsut would be provided to BLM, the state, NSB, and the local community and tribal government, pursuant to Best Management Practice A-10(h); US DOI BLM 2014). The permittee would provide funding for BLM technical review of these documents. The permittee would also provide funds to BLM, via an ongoing cost reimbursement agreement, to support BLM's independent verification of the air quality monitoring and reports.

Required Operating Procedure 8

Objective: Ensure that permitted activities do not create human health risks by contaminating subsistence foods.

Requirement/Standard: A lessee/operator/contractor proposing a permanent oil and gas development would design and implement a monitoring study of contaminants in locally used subsistence foods. The monitoring study preparers would examine subsistence foods for all contaminants that could be associated with the proposed development. The study would identify the level of contaminants in subsistence foods before the proposed permanent oil and gas development and would monitor the level of these contaminants throughout the operation and abandonment phases. If ongoing monitoring detects a measurable and persistent increase in a contaminant in subsistence foods, the operator would design and implement a study to determine how much, if any, of the increase in the contaminant in subsistence foods originates from the operator's activities. If the study preparers determine that a portion of the increase in

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">contamination in subsistence foods is caused by the operator’s activities, the BLM Authorized Officer may require changes in the operator’s processes to reduce or eliminate emissions of the contaminant. The design of the study must meet the approval of the BLM Authorized Officer, who may coordinate with appropriate entities before approving the study design. The BLM Authorized Officer may require or authorize changes in the design of the studies throughout the operations and abandonment period or terminate or suspend studies if results warrant.</td></tr>
<tr><td colspan="3">WATER USE FOR PERMITTED ACTIVITIES</td></tr>
<tr><td colspan="3">Required Operating Procedure 9

<u>Objective</u>: Maintain populations of, and adequate habitat for, fish and aquatic invertebrates.

<u>Requirement/Standard</u>: Withdrawal of unfrozen water from rivers and streams during winter is prohibited. The removal of ice aggregate from grounded areas 4 feet deep or less may be authorized from rivers on a site-specific basis.</td></tr>
<tr><td colspan="2">Required Operating Procedure 10

<u>Objective</u>: Maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for, fish, aquatic invertebrates, and waterfowl.

<u>Requirement/Standard</u>: Withdrawal of unfrozen water from lakes and the removal of ice aggregate from grounded areas 4 feet deep or less may be authorized on a site-specific basis, depending on water volume and depth and the waterbody’s fish community. Current water use requirements are as follows:
a. Lakes with sensitive fish (i.e., any fish except ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 15% of calculated volume deeper than 7 feet; only ice aggregate may be removed from lakes that are 7 feet deep or less.
b. Lakes with only non-sensitive fish (i.e., ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 30% of calculated volume deeper than 5 feet; only ice aggregate may be removed from lakes that are 5 feet deep or less.
c. Lakes with no fish, regardless of depth: water available for use is limited to 35% of total lake volume.
d. In lakes where unfrozen water and ice aggregate are both removed, the total use would not exceed the respective 15%, 30%, or 35% volume calculations.
e. Additional modeling or monitoring may be required to assess water level and water quality conditions before, during, and after water use from any fish-bearing lake or lake of special concern.
f. Any water intake structures in fish-bearing or non-fish-bearing waters</td><td>Required Operating Procedure 10

<u>Objective</u>: Maintain natural hydrologic regimes in soils surrounding lakes and ponds and maintain populations of, and adequate habitat for, fish, aquatic invertebrates, and waterfowl.

<u>Requirement/Standard</u>: Withdrawing unfrozen water from lakes and removing ice aggregate from grounded areas 4 feet deep or less may be authorized on a site-specific basis, depending on water volume and depth and the water body’s fish community. Current water use requirements are as follows:
a. Lakes with any fish except ninespine stickleback or Alaska blackfish: unfrozen water available for withdrawal is limited to 15% of calculated volume deeper than 7 feet; only ice aggregate may be removed from lakes that are 7 feet deep or less.
b. Lakes with only ninespine stickleback or Alaska blackfish: unfrozen water available for withdrawal is limited to 30% of calculated volume deeper than 5 feet; only ice aggregate may be removed from lakes that are 5 feet deep or less.
c. Lakes with no fish, regardless of depth: water available for use is limited to 35% of total lake volume.
d. In lakes where unfrozen water and ice aggregate are both removed, the total use would not exceed the respective 15%, 30%, or 35% volume calculations.
e. Additional modeling or monitoring may be required to assess water level and water quality conditions before, during, and after water use from any fish-bearing lake or lake of special concern.
f. Any water intake structures in fish-bearing or non-fish-bearing waters would be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. Note: All water withdrawal equipment must be</td></tr>
</table>

Alternative B Alternative C	Alternative D
would be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. **Note:** All water withdrawal equipment must be equipped with and use fish screening devices approved by the Alaska Department of Fish and Game, Division of Habitat. g. Compacting snow cover or removing snow from fish-bearing water bodies would be prohibited, except at approved ice road crossings, water pumping stations on lakes, or areas of grounded ice.	equipped with and use fish screening devices approved by the Alaska Department of Fish and Game, Division of Habitat. g. Compacting snow cover or removing snow from fish-bearing water bodies would be prohibited, except at approved ice road crossings, water pumping stations on lakes, or areas of grounded ice. h. Additional modeling and monitoring of lake recharge may be required to ensure natural hydrologic regime, water quality, and aquatic habitat for migratory birds.
WINTER OVERLAND MOVES AND SEISMIC WORK The following ROPs apply to overland and over-ice moves, seismic work, and any similar cross-country vehicle use and heavy equipment on surfaces without roads during winter. These restrictions do not apply to the use of such equipment on ice roads after they are constructed.	
Required Operating Procedure 11 <u>Objective</u>: Protect grizzly bear, polar bear, and marine mammal denning and birthing locations. <u>Requirement/Standard</u>: a. Cross-country use of heavy equipment and seismic activity is prohibited within 0.5 miles of occupied grizzly bear dens identified by the Alaska Department of Fish and Game, unless alternative protective measures are approved by the BLM Authorized Officer, in consultation with the Alaska Department of Fish and Game. b. Cross-country use of heavy equipment and seismic activity during surveys is prohibited within 1 mile of known or observed polar bear dens or seal birthing lairs. Operators near coastal areas would conduct a survey for potential polar bear dens and seal birthing lairs and consult with the USFWS or NOAA Fisheries, as appropriate, before initiating activities in coastal habitat between October 30 and April 15.	***Required Operating Procedure 11*** <u>Objective</u>: Protect grizzly bear, polar bear, and marine mammal denning and birthing locations. <u>Requirement/Standard</u>: a. All oil and gas activity, including cross-country use of vehicles, equipment, and seismic survey activity, is prohibited within 0.5 miles of known or observed grizzly bear dens, unless alternative protective measures are approved by the BLM Authorized Officer. b. All oil and gas activity, including cross-country use of vehicles, equipment, and seismic survey activity, is prohibited within 1 mile of known or observed polar bear dens, unless alternative protective measures are approved by the BLM Authorized Officer. c. All oil and gas activity, including cross-country use of vehicles, equipment, and seismic survey activity, is prohibited within 1 mile of known or observed seal birthing lairs, unless alternative protective measures are approved by the BLM Authorized Officer. d. Between October 30 and April 15 of any year, a lessee/operator/contractor working in polar bear denning and seal birthing habitat would conduct a survey for polar bear dens and seal birthing lairs, in consultation with the USFWS, or NOAA, or both, as appropriate, throughout the planned area of activities and before initiating activities.
Required Operating Procedure 12 <u>Objective</u>: Protect stream banks, minimize soils compaction and the breakage, abrasion, compaction, or displacement of vegetation.	***Required Operating Procedure 12*** <u>Objective</u>: Protect stream banks and minimize soil compaction and the breakage, abrasion, compaction, or displacement of vegetation.

Alternative B **Alternative C**

Requirement/Standard:

a. Ground operations would be allowed only when frost and snow cover are at sufficient depths to protect the tundra. Ground operations would cease when the spring snowmelt begins (approximately May 5 in the foothills, where elevations reach or exceed 500 feet and approximately May 15 in the northern coastal areas). The exact dates would be determined by the BLM Authorized Officer.

b. Low-ground-pressure vehicles would be used for on-the-ground activities off ice roads or pads. Low- ground-pressure vehicles would be selected and operated in a manner that eliminates direct impacts on the tundra by shearing, scraping, or excessively compacting the tundra mat. **Note:** This provision does not include the use of heavy equipment, such as front-end loaders and similar equipment required during ice road construction.

c. Bulldozing tundra mat and vegetation, trails, or seismic lines is prohibited; however, on existing trails, seismic lines, or camps, clearing drifted snow is allowed to the extent that the tundra mat is not disturbed.

d. To reduce the possibility of ruts, vehicle operators would avoid using the same trails for multiple trips, unless necessitated by serious safety or superseding environmental concern, as approved by the BLM Authorized Officer. This provision does not apply to hardened snow trails for use by low-ground-pressure vehicles, such as Rolligons.

e. The location of ice roads would be designed and located to minimize soil compaction and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year.

Alternative D

Requirement/Standard:

a. Ground operations would be allowed only when frost depth is at sufficient depths and snow cover is at sufficient depths and density to protect the tundra, as determined by the BLM Authorized Officer. Soils would be frozen to at least 23° Fahrenheit to at least 1 foot below the lowest surface height (e.g., intertussock space). Snow depth and snow density would amount to no less than a Snow Water Equivalent of 3 inches over the highest tussock. Ground operations would cease when snow depth and density no longer meet criteria. Snow depth and density would reflect the time of the planned operation.

Snow Depth times Density to achieve Snow Water Equivalent of 3 Inches

Snow Specific Gravity	Needed Snow Depth (Inches)
0.05	60
0.1	30
0.15	20
0.2	15
0.25	12
0.3	10
0.35	9
0.4	8
0.45	7
0.5	6

b. Low-ground-pressure vehicles would be used for on-the-ground activities off ice roads or pads. The vehicles would be selected and operated in a manner that eliminates direct impacts on the tundra by shearing, scraping, or excessively compacting the tundra mat. **Note:** This provision does not include the use of heavy equipment, such as front-end loaders and similar equipment required during ice road construction.

c. Bulldozing tundra mat and vegetation to create trails or seismic lines is prohibited. Clearing drifted snow is allowed on existing snow trails, snow pads for camps, ice roads, or ice pads, to the extent that the tundra mat is not disturbed.

d. To reduce the possibility of ruts, vehicle operators would avoid using the same trails for multiple trips, unless necessitated by serious safety or any superseding environmental concern. This provision does not apply to

Alternative B	Alternative C	Alternative D
		hardened snow trails for use by low-ground-pressure vehicles, such as Rolligons. e. The location of ice roads would be designed and located to minimize soil compaction and the breakage, abrasion, compaction, or displacement of vegetation. Offsets may be required to avoid using the same route or track in the subsequent year. f. To minimizes changes in snow distribution resulting from oil and gas activities that could affect bear denning habitat and water quality and quantity, the use of snow fences would require approval by the BLM Authorized Officer. g. Seismic operations and winter overland travel may be monitored by agency representative, and the operator may be required to accommodate the representative during operations.
Required Operating Procedure 13 <u>Objective</u>: Maintain natural spring (breakup) runoff patterns and fish passage, minimize flooding from human-made obstructions, prevent streambed sedimentation and scour, and protect water quality and stream banks. <u>Requirement/Standard:</u> Waterway courses would be crossed using a low-angle approach. Crossings that are reinforced with additional snow or ice ("bridges") would be removed, breached, or slotted before spring breakup. Ramps and bridges would be substantially free of soil and debris.		
Required Operating Procedure 14 <u>Objective</u>: Avoid additional freeze-down of deep-water pools harboring over-wintering fish and aquatic invertebrates that fish prey on. <u>Requirement/Standard</u>: Travel up and down streambeds is prohibited unless it can be demonstrated that there would be no additional impacts from such travel on over-wintering fish or the aquatic invertebrates they prey on. Rivers, streams, and lakes would be crossed at areas of grounded ice whenever possible.		***Required Operating Procedure 14*** <u>Objective</u>: Avoid additional freeze-down of aquatic habitat harboring over-wintering fish and aquatic invertebrates that fish prey on. <u>Requirement/Standard</u>: Travel up and down streambeds is prohibited unless it can be demonstrated that there would be no additional impacts from such travel on over-wintering fish or the aquatic invertebrates they prey on and water quality. Rivers, streams, and lakes would be crossed at areas of grounded ice or with the approval of the BLM Authorized Officer, and when it has been demonstrated that no additional impacts would occur on fish or aquatic invertebrates.
Required Operating Procedure 15 <u>Objective</u>: Minimize the effects of high-intensity acoustic energy from seismic surveys on fish.		***Required Operating Procedure 15*** <u>Objective</u>: Minimize the effects of high-intensity acoustic energy from seismic surveys on fish.

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="2"><u>Requirement/Standard</u>:
a. When conducting vibroseis[1]-based surveys above potential fish overwintering areas (water 6 feet deep or greater, ice plus liquid depth), lessees/operators/contractors would follow recommendations by Morris and Winters (2005): only a single set of vibroseis shots would be conducted if possible; if multiple shot locations are required, these would be conducted with minimal delay; multiple days of vibroseis activity above the same over-wintering area would be avoided if possible.</td><td><u>Requirement/Standard</u>:
a. Seismic surveys would not be conducted over unfrozen water with fish over-wintering potential.</td></tr>
<tr><td colspan="3">Required Operating Procedure 16
<u>Objective</u>: Reduce changes in snow distribution associated with the use of snow fences to protect water quantity and wildlife habitat, including snow drifts used by denning polar bears.

<u>Requirement/Standard</u>: The use of snow fences to reduce or increase snow depth requires permitting by the BLM Authorized Officer.</td></tr>
<tr><td colspan="3">OIL AND GAS EXPLORATORY DRILLING</td></tr>
<tr><td colspan="2">Required Operating Procedure 17

<u>Objectives</u>: Protect water quality in fish-bearing water bodies and minimize alteration of riparian habitat.

<u>Requirement/Standard</u>: Exploratory drilling is prohibited in fish-bearing rivers and streams and their active floodplains and other fish-bearing water bodies.</td><td>Required Operating Procedure 17

<u>Objectives</u>: Protect water quality in fish-bearing water bodies and minimize alteration of riparian habitat.

<u>Requirement/Standard</u>: Exploratory drilling is prohibited in fish-bearing rivers and streams and other fish-bearing water bodies. On a case-by-case basis, the BLM Authorized Officer may consider exploratory drilling in floodplains of fish-bearing rivers and streams.</td></tr>
<tr><td colspan="3">Required Operating Procedure 18

<u>Objective</u>: Minimize surface impacts from exploratory drilling.

<u>Requirement/Standard</u>: Construction of a gravel road for permanent oil and gas facilities would be prohibited for exploratory drilling. Use of a previously constructed road or pad may be permitted if it is environmentally preferred.</td></tr>
<tr><td colspan="3">FACILITY DESIGN AND CONSTRUCTION</td></tr>
<tr><td colspan="3">Required Operating Procedure 19

<u>Objective</u>: Protect subsistence use and access to subsistence hunting and fishing areas and minimize the impact of oil and gas activities on air, land, water, fish, and wildlife resources.</td></tr>
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[1]Vibroseis is a truck-mounted system that uses a large oscillating mass to put a range of frequencies into the earth.

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3"><u>Requirement/Standard</u>: All roads must be designed, constructed, maintained, and operated to create minimal environmental impacts and to protect subsistence use and access to subsistence hunting and fishing areas. The BLM Authorized Officer would consult with appropriate entities before approving construction of roads. Subject to approval by the BLM Authorized Officer, the construction, operation and maintenance of oil and gas field roads is the responsibility of the lessee/operator/contractor unless the construction, operation, and maintenance of roads are assumed by the appropriate governing entity.</td></tr>
<tr><td colspan="3">Required Operating Procedure 20

<u>Objective</u>: Protect water quality and the diversity of fish, aquatic invertebrates and wildlife populations and habitats.

<u>Requirement/Standard:</u>
a. Permanent oil and gas facilities, including roads, airstrips, and pipelines, are prohibited within 500 feet, as measured from the ordinary high watermark, of fish-bearing water bodies unless further setbacks are stipulated under Lease Stipulation 1. Pipeline and road crossings would be permitted on a case-by-case basis by the BLM Authorized Officer, following coordination with the appropriate entities.
b. Exploration and construction camps are prohibited on frozen lakes and river ice.
c. Siting camps on river sand and gravel bars is allowed and encouraged. Where trailers or modules must be leveled and the surface is vegetation, they would be leveled using blocking in a way that preserves the vegetation.</td></tr>
<tr><td colspan="3">Required Operating Procedure 21

<u>Objective</u>: Maintain free passage of marine and anadromous fish and protect subsistence use and access to subsistence hunting and fishing.

<u>Requirement/Standard:</u> Causeways and docks are prohibited in river mouths and deltas. Artificial gravel islands and bottom-founded structures are prohibited in river mouths and active stream channels on river deltas.</td></tr>
<tr><td colspan="3">Required Operating Procedure 22

<u>Objective</u>: Maintain free passage of marine and anadromous fish and protect subsistence use and access to subsistence hunting and fishing.

<u>Requirement/Standard:</u> Causeways, docks, artificial islands, and bottom-founded drilling structures would be designed to ensure free passage of marine and anadromous fish and to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics. A monitoring program, developed in coordination with appropriate entities, would be required to address the objectives of water quality and free passage of fish.</td></tr>
<tr><td colspan="2">Required Operating Procedure 23

<u>Objective</u>: Minimize impacts of the development footprint.

<u>Requirement/Standard</u>: Facilities would be designed and located to minimize the development footprint. Issues and methods that are to be considered are as follows:
a. Using maximum extended-reach drilling for production drilling to minimize the number of pads and the network of roads between pads
b. Sharing facilities with existing development
c. Collocating all oil and gas facilities with drill pads, except airstrips,</td><td>Required Operating Procedure 23

<u>Objective</u>: Minimize impacts of the development footprint.

<u>Requirement/Standard</u>: Facilities would be designed and located to minimize the development footprint and impacts on other purposes of the Arctic Refuge. Issues and methods that are to be considered are as follows:
a. Using maximum extended-reach drilling for production drilling to minimize the number of pads and the network of roads between pads
b. Sharing facilities with existing development
c. Collocating all oil and gas facilities with drill pads, except airstrips, docks, base</td></tr>
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<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="2">docks, base camps, and seawater-treatment plants;
d. Using gravel-reduction technologies, e.g., insulated or pile-supported pads
e. Coordinating facilities with infrastructure in support of adjacent development
Note: Where aircraft traffic is a concern, consideration would be given to balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations.</td><td>camps, and seawater-treatment plants;
d. Using gravel-reduction technologies, e.g., insulated or pile-supported pads
e. Coordinating facilities with infrastructure in support of adjacent development
f. Locating facilities and other infrastructure outside areas identified as important for wildlife habitat, subsistence uses, and recreational uses;
g. Where aircraft traffic is a concern, balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations</td></tr>
<tr><td colspan="3">Required Operating Procedure 24

<u>Objective</u>: Reduce the potential for ice-jam flooding, damage from aufeis, impacts on wetlands and floodplains, erosion, alteration of natural drainage patterns, and restriction of fish passage.

<u>Requirement/Standard</u>:
a. To allow for sheet flow and floodplain dynamics and to ensure fish passage and passage of other organisms, bridges are preferred over culverts, if technically feasible. When necessary, culverts could be constructed on smaller streams, if they are large enough to avoid restricting fish passage or adversely affecting natural stream flow.
b. To ensure that crossings provide for fish passage, all proposed crossing designs would adhere to the best management practices outlined in Fish Passage Design Guidelines, developed by the USFWS Alaska Fish Passage Program (June 29, 2018), Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings (US Forest Service 2008), and other generally accepted best management procedures prescribed by the BLM Authorized Officer and the USFWS.
c. In addition to the best management practices outlined in the aforementioned documents for stream simulation design, the design engineer would ensure that crossing structures are designed for aufeis, permafrost, sheet flow, additional freeboard during breakup, and other unique conditions of the arctic environment.</td></tr>
<tr><td colspan="3">Required Operating Procedure 25

<u>Objective</u>: Minimize disruption of caribou movement and subsistence use.

<u>Requirement/Standard</u>: Pipelines and roads would be designed to allow the free movement of caribou and the safe, unimpeded passage of those participating in subsistence activities. Listed below are the accepted design practices.
a. Aboveground pipelines would be elevated a minimum of 7 feet, as measured from the ground to the bottom of the pipeline at vertical support members.
b. In areas where facilities or terrain may funnel caribou movement or impede subsistence or public access, ramps of appropriate angle and design over pipelines, buried pipelines, or pipelines buried under roads may be required by the BLM Authorized Officer, in coordination with the appropriate entity.
c. A minimum distance of 500 feet between pipelines and roads would be maintained. Separating roads from pipelines may not be feasible within narrow land corridors between lakes and where pipelines and roads converge on a drill pad. Where it is not feasible, alternative pipeline routes, designs, and possible burial under the road for pipeline road crossings would be considered by the BLM Authorized Officer.
d. Aboveground pipelines would have a nonreflective finish.</td></tr>
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Alternative B Alternative C	Alternative D
Required Operating Procedure 26 Objective: Minimize the impact of mineral materials mining on air, land, water, fish, and wildlife resources. Requirement/Standard: Gravel mine site design and reclamation would be done in accordance with a plan approved by the BLM Authorized Officer. The plan would be developed in coordination with the appropriate entity and would take into consideration the following: a. Locations outside the active floodplain b. Design and construction of gravel mine sites in active floodplains to serve as water reservoirs for future use c. Potential use of the site for enhancing fish and wildlife habitat d. Potential storage and reuse of sod/overburden for the mine site or at other disturbed sites on the North Slope	***Required Operating Procedure 26*** Objective: Minimize the impact of mineral materials mining on air, land, water, fish, and wildlife resources. Requirement/Standard: Gravel mine site design and reclamation would be in accordance with a plan approved by the BLM Authorized Officer. The plan would take into consideration the following: a. Design and construction of gravel mine sites to serve as water reservoirs for future use may not be considered in active floodplains of the four rivers that support populations of freshwater, anadromous, or endemic fish: Canning, Sadlerochit, Hulahula, and Aichilik Rivers b. Locations outside the active floodplain for all other rivers c. Design and construction of gravel mine sites in active floodplains to serve as water reservoirs for future use d. Potential use of the site for enhancing fish and wildlife habitat, while preventing entrapment of native fishes e. Potential storage and reuse of sod/overburden for the mine site or at other disturbed sites on the North Slope f. All constructed water storage reservoirs would be a sufficient distance from drill sites, fueling stations, or other temporary or permanent sites that generate or maintain more than 220 gallons of fuel, drilling fluids, or other hazardous materials to avoid contamination via surface water or groundwater of the storage reservoir. The lessee/operator/contractor would implement a water quality and contaminants monitoring program for any constructed water storage facility.
Required Operating Procedure 27 Objective: Minimize human-caused increases in populations of predators of ground-nesting birds. Requirement/Standard: a. Lessees/operator/contractor would use best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes. The lessee/operator/contractor would provide the BLM Authorized Officer with an annual report on the use of oil and gas facilities by ravens, raptors, and foxes as nesting, denning, and shelter sites. b. Feeding of wildlife is prohibited.	***Required Operating Procedure 27*** Objective: Minimize human-caused increases in populations of predators of ground-nesting birds. Requirement/Standard: a. Lessee/operator/contractor would use best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes. The lessee/operator/contractor would provide the BLM Authorized Officer with an annual report on the use of oil and gas facilities by ravens, raptors, and foxes as nesting, denning, and shelter sites. b. Feeding of wildlife and allowing wildlife to access human food or odor-emitting waste is prohibited.

Alternative B	Alternative C	Alternative D
Required Operating Procedure 28 Objective: Reduction of risk of attraction and collisions between migrating birds and oil and gas and related facilities during low light conditions. Requirement/Standard: All structures would be designed to direct artificial exterior lighting, from August 1 to October 31, inward and downward, rather than upward and outward, unless otherwise required by the Federal Aviation Administration.		
E-11 Required Operating Procedure Objective: Minimize the take of bird species, particularly BLM Special Status Species and those listed under the Endangered Species Act (ESA), from direct or indirect interaction with oil and gas facilities. Requirement/Standard: In accordance with the guidance below, before facility construction is approved, aerial surveys of the species below would be conducted in any area proposed for development. *Special conditions in spectacled or Steller's eiders habitats:* a. Surveys would be conducted by the lessee/operator/contractor for at least 3 years before authorization of construction if such construction is in the USFWS North Slope eider survey area and at least 1 year outside that area. Results of aerial surveys and habitat mapping may require additional ground nest surveys. Spectacled and Steller's eider surveys would be conducted following accepted BLM-protocol. Information gained from these surveys would be used to make infrastructure siting decisions, as discussed in subparagraph b, below. b. If spectacled or Steller's eiders are determined to be present in the proposed development area, the applicant would work with the USFWS and BLM early in the design process to site roads and facilities to minimize impacts on nesting and brood-rearing eiders and their preferred habitats. Such consultation would address timing restrictions and other temporary mitigating measures, location of permanent facilities, placement of fill, alteration of eider habitat, aircraft operations, and management of high noise levels. c. To reduce the possibility of spectacled or Steller's eiders colliding with aboveground power and communication utility lines, such lines would either be buried in access roads or suspended on vertical support members, except in rare cases, limited in extent. Exceptions are limited to the following situations, and must be reported to the USFWS when exceptions are authorized: i. Overhead power or communication lines may be allowed when located entirely within the boundaries of a facility pad. ii. Overhead power or communication lines may be allowed when engineering constraints at the specific and limited location make it infeasible to bury or connect the lines to a vertical support member. iii. Overhead power or communication lines may be allowed in situations when human safety would be compromised by other methods. d. To reduce the likelihood of spectacled or Steller's eiders and other birds colliding with them, communication towers would be located, to the extent practicable, on existing pads and as close as possible to buildings or other structures and on the east or west side of buildings or other structures, if possible. Support wires associated with communication towers, radio antennas, and other similar facilities would be avoided to the extent practicable. If support wires are necessary, they would be clearly marked along their entire length to improve visibility to low-flying birds. Such markings would be developed through consultation with the USFWS. *Special conditions in yellow-billed loon habitats:* a. Aerial surveys would be conducted by the lessee/operator/contractor for at least 3 years before authorization of construction of facilities proposed for development that are within 1 mile of a lake of 25 acres or larger. These surveys along shorelines of large lakes would be conducted following accepted		

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">BLM protocol during nesting in late June and during brood rearing in late August.
b. Should yellow-billed loons be present, the design and location of facilities must be such that disturbance is minimized. The default standard mitigation is a 1-mile buffer around all recorded nest sites and a minimum 1,625-foot buffer around the remainder of the shoreline. Development would generally be prohibited within buffers unless no other option exists.

Protections for Birds
a. To reduce the possibility of birds colliding with aboveground utility lines (power and communication), such lines would either be buried in access roads or would be suspended on vertical support members, except in rare cases, limited in extent. Exceptions are limited to the following situations:
i. Overhead power or communication lines may be allowed when located entirely within the boundaries of a facility pad;
ii. Overhead power or communication lines may be allowed when engineering constraints at the specific and limited location make it infeasible to bury or connect the lines to a vertical support member; or
iii. Overhead power or communication lines may be allowed in situations when human safety would be compromised by other methods.
b. To reduce the likelihood of birds colliding with them, communication towers would be located, to the extent practicable, on existing pads and as close as possible to buildings or other structures and on the east or west side of buildings or other structures, if possible. Support wires associated with communication towers, radio antennas, and other similar facilities, would be avoided to the extent practicable. If support wires are necessary, they would be clearly marked along their entire length to improve visibility to low-flying birds. Such markings would be developed through consultation with the USFWS.</td></tr>
<tr><td colspan="3">E-12 Required Operating Practice

<u>Objective</u>: Use ecological mapping as a tool to assess wildlife habitat before development of permanent facilities to conserve important habitat types.

<u>Requirement/Standard</u>: An ecological land classification map of the area would be developed before approval of facility construction. The map would integrate geomorphology, surface form, and vegetation at a scale and level of resolution and position accuracy adequate for detailed analysis of development alternatives. The map would be prepared in time to plan one season of ground-based wildlife surveys, if deemed necessary by the BLM Authorized Officer, before the exact facility location and facility construction is approved.</td></tr>
<tr><td colspan="3">E-13 Required Operating Procedure

<u>Objective</u>: Protect cultural and paleontological resources.

<u>Requirement/Standard</u>: The lessee/operator/contractor would conduct a cultural and paleontological resources survey before any ground-disturbing activity, based on a study designed and approved by the BLM Authorized Officer. If any potential cultural or paleontological resource is found, the lessee/operator/contractor would notify the BLM Authorized Officer and would suspend all operations in the immediate area until she or he issues a written authorization to proceed.</td></tr>
<tr><td colspan="3">E-14 Required Operating Procedure

<u>Objective</u>: Ensure the passage of fish at stream crossings.

<u>Requirement/Standard</u>: To ensure that crossings provide for fish passage, all proposed crossing designs would adhere to the best management practices outlined in Stream Crossing Design Procedure for Fish Streams on the North Slope Coastal Plain (McDonald et al. 1994), Fundamentals of Culvert Design for</td></tr>
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<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">Passage of Weak-Swimming Fish (Behlke et al. 1991), and other generally accepted best management procedures prescribed by the BLM Authorized Officer. To adhere to these best management practices, at least 3 years of hydrologic and fish data would be collected by the lessee/operator/contractor for any proposed crossing of a stream whose structure is designed to occur, wholly or partially, below the stream’s ordinary high watermark. These data would include the highest and lowest range of water levels at the location of the planned crossing and the seasonal distribution and composition of fish populations using the stream.</td></tr>
<tr><td colspan="3">E-15 Required Operating Procedure

<u>Objective</u>: Prevent or minimize the loss of nesting habitat for cliff-nesting raptors.

<u>Requirement/Standard</u>:
a. Removing greater than 100 cubic yards of bedrock outcrops, sand, or gravel from cliffs would be prohibited.
b. Any extraction of sand or gravel from an active river or stream channel would be prohibited, unless preceded by a hydrological study that indicates no potential impact on the integrity of the river bluffs.</td></tr>
<tr><td colspan="3">E-16 Required Operating Procedure

<u>Objective</u>: Prevent or minimize the loss of raptors due to electrocution by power lines.

<u>Requirement/Standard</u>: Comply with the most up-to-date, industry-accepted, suggested practices for raptor protection on power lines. Current accepted standards were published in Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006, by the Avian Power Line Interaction Committee and are updated as needed.</td></tr>
<tr><td colspan="3">E-17 Required Operating Procedure

<u>Objective</u>: Avoid and reduce temporary impacts on productivity from disturbance near Steller’s or spectacled eider nests.

<u>Requirement/Standard</u>: Ground-level vehicle or foot traffic within 656 feet of occupied Steller’s or spectacled eider nests, from June 1 through August 15, would be restricted to existing thoroughfares, such as pads and roads. Construction of permanent facilities, placement of fill, alteration of habitat, and introduction of high noise levels within 656 feet of occupied Steller’s or spectacled eider nests would be prohibited. Between June 1 and August 15, support/construction activity must occur off existing thoroughfares, and USFWS-approved nest surveys must be conducted during mid-June before the activity is approved. Collected data would be used to evaluate whether the action could occur based on a 656-foot buffer around nests or if the activity would be delayed until after mid-August once ducklings are mobile and have left the nest site. The BLM would also work with the USFWS to conduct nest surveys or oil spill response training in riverine, marine, and intertidal areas that is within 656 feet of shore outside sensitive nesting/brood-rearing periods. The protocol and timing of nest surveys for Steller’s or spectacled eiders would be determined in cooperation with and must be approved by the USFWS. Surveys would be supervised by biologists who have previous experience with Steller’s or spectacled eider nest surveys.</td></tr>
<tr><td colspan="3">E-18 Required Operating Procedure

<u>Objective</u>: Provide information to be used in monitoring and assessing wildlife movements during and after construction.

<u>Requirement/Standard</u>: A representation, in the form of ArcGIS-compatible shape-files, of all new infrastructure construction would be provided to the BLM Authorized Officer. During the planning and permitting phase, GIS shape files representing proposed locations would be provided. Within 6 months of</td></tr>
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Alternative B	Alternative C	Alternative D
construction completion, shape-files (within GPS accuracy) of all new infrastructure would be provided. Infrastructure includes all gravel roads and pads, facilities built on pads, pipelines, and independently constructed power lines (as opposed to those incorporated in pipeline design). Gravel pads would be included as polygon features. Roads, pipelines, and power lines may be represented as line features but must include ancillary data to denote such data as width and number pipes. Poles for power lines may be represented as point features. Ancillary data would include construction beginning and ending dates.		
USE OF AIRCRAFT FOR PERMITTED ACTIVITIES		
F-1 Required Operating Procedure Objective: Minimize the effects of low-flying aircraft on wildlife, subsistence activities, local communities, and recreationists of the area, including sport hunters and anglers. Requirement/Standard: The operator would ensure that operators of aircraft used for permitted oil and gas activities and associated studies maintain altitudes according to the following guidelines (**Note:** This ROP is not intended to restrict flights necessary to survey wildlife to gain information necessary to meet the stated objectives of the stipulations and ROPs; however, such flights would be restricted to the minimum necessary to collect such data.): a. Aircraft would maintain an altitude of at least 1,500 feet AGL when within 0.5 miles of cliffs identified as raptor nesting sites from April 15 through August 15 and within 0.5 miles of known gyrfalcon nest sites from March 15 to August 15, unless doing so would endanger human life or violate safe flying practices. Permittees would obtain information from the BLM necessary to plan flight routes when routes may go near falcon nests. b. Aircraft operators would maintain an altitude of at least 1,000 feet AGL (except for takeoffs and landings) over caribou winter ranges, from December 1 through May 1, unless doing so would endanger human life or violate safe flying practices. Caribou wintering areas would be defined annually by the BLM Authorized Officer. The BLM would consult annually with the Alaska Department of Fish and Game in defining caribou winter ranges. c. Land users would submit an aircraft use plan as part of an oil and gas exploration or development proposal. The plan would address strategies to minimize impacts on subsistence hunting and associated activities, including the number of flights, type of aircraft, and flight altitudes and routes, and would also include a plan to monitor flights. Proposed aircraft use plans would be reviewed by the appropriate entities. Consultations with these same agencies would be required if unacceptable disturbance is identified by subsistence users. Adjustments, including possible suspension of all flights, may be required by the BLM Authorized Officer if resulting disturbance is determined to be unacceptable. The number of takeoffs and landings to support oil and gas operations with necessary materials and supplies would be limited to the maximum extent possible. During the design of proposed oil and gas facilities, larger landing strips and storage areas would be considered to allow larger aircraft to be used, resulting in fewer flights to the facility. d. Use of aircraft, especially rotary wing aircraft, would be kept to a minimum near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting and fall caribou and moose hunting). e. Operators of aircraft used for permitted activities would maintain an altitude of at least 2,000 feet AGL (except for takeoffs and landings) over the Porcupine caribou herd calving and post-calving area from May 20 through July 20, unless doing so would endanger human life or violate safe flying practices. Aircraft use (including fixed-wing and helicopter) by oil and gas operators over any identified goose molting area would be minimized from May 20 through August 20, unless doing so would endanger human life or violate safe flying practices. f. Hazing wildlife by aircraft is prohibited. Pursuing running wildlife is hazing. If wildlife begins to run as an aircraft approaches, the aircraft is too close and the operator must break away. Operators of aircraft used as part of a BLM-authorized activity along the coast and shore fast ice zone would maintain a minimum altitude of 3,000 feet and a buffer of 1 mile from aggregations of seals, unless doing so would endanger human life or violate safe flying practices. g. Aircraft would maintain an altitude of at least 1,500 feet AGL of polar bears and grizzly bears.		

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<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">OIL AND GAS FIELD ABANDONMENT</td></tr>
<tr><td colspan="2">G-1 Required Operating Procedure

Objective: Ensure ongoing and long-term restoration of land meets the purposes of the Arctic Refuge.

Requirement/Standard: Before final abandonment, land used for oil and gas infrastructure—including well pads, production facilities, access roads, and airstrips—would be reclaimed to ensure eventual restoration of ecosystem function. The leaseholder would develop and implement a BLM-approved abandonment and reclamation plan. The plan would describe short-term stability, visual, hydrological, and productivity objectives and steps to be taken to ensure eventual ecosystem restoration to the land's previous hydrological, vegetative, and habitat condition. The BLM may grant exceptions to satisfy stated environmental or public purposes.</td><td>G-1 Required Operating Procedure

Objective: Ensure ongoing and long-term reclamation of land to its previous condition and use.

Requirement/Standard:
a. Oil and gas infrastructure, including gravel pads, roads, airstrips, wells and production facilities, would be removed and the land restored on an ongoing basis, as extraction is complete.
b. Before final abandonment, land used for oil and gas infrastructure—including well pads, production facilities, access roads, and airstrips—would be restored to ensure eventual restoration of ecosystem function and meet minimal standards for eligibility of wilderness designation. The leaseholder would develop and implement an abandonment and reclamation plan approved by the BLM Authorized Officer. The plan would describe short-term stability, visual, hydrological, and productivity objectives and steps to be taken to ensure eventual ecosystem restoration to the land's previous hydrological, vegetative, and habitat condition, and wilderness eligibility. The BLM Authorized Officer may grant exceptions to satisfy stated environmental or public purposes.</td></tr>
<tr><td colspan="3">SUBSISTENCE CONSULTATION FOR PERMITTED ACTIVITIES</td></tr>
<tr><td colspan="2">H-1 Required Operating Procedure

Objective: Provide opportunities for subsistence users to participate in planning and decision-making to prevent unreasonable conflicts between subsistence uses and other activities.

Requirement/Standard: The lessee/operator/contractor would coordinate directly with affected communities, using the following guidelines:
a. Before submitting an application to the BLM, the applicant would consult with directly affected subsistence communities, the Native Village of Kaktovik, NSB, and the North Slope and Eastern Interior Subsistence Advisory Panels. They would discuss the siting, timing and methods of their proposed operations to help discover local traditional and scientific knowledge. This is to minimize impacts on subsistence uses. Through this consultation, the applicant would make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that proposed activities</td><td>H-1 Required Operating Procedure

Objective: Provide opportunities for subsistence users to participate in planning and decision-making to prevent unreasonable conflicts between subsistence uses and other activities.

Requirement/Standard: The lessee/operator/contractor would consult directly with affected communities, using the following guidelines:
a. Before submitting an application to the BLM, the applicant would coordinate with directly affected subsistence communities, including the Native Village of Kaktovik, the NSB, and the North Slope and Eastern Interior Subsistence Advisory Councils. They would discuss the siting, timing, and methods of their proposed operations to help discover local traditional and scientific knowledge. This would result in measures that minimize impacts on subsistence uses. Through this consultation, the applicant would make every reasonable effort, including such mechanisms as conflict avoidance agreements and mitigating measures, to ensure that proposed activities would not result</td></tr>
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<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="2">would not result in unreasonable interference with subsistence activities. In the event that no agreement is reached between the parties, the BLM Authorized Officer would consult with the involved parties and determine which activities would occur, including the time frames.
b. Applicants would submit documentation of consultation as part of operation plans to the North Slope and Eastern Interior Subsistence Advisory Panels for review and comment. Applicants must allow time for the BLM to conduct formal government-to-government consultation with Native Tribal governments if the proposed action requires it.
c. A plan would be developed that shows how the activity, in combination with other activities in the area, would be scheduled and located to prevent unreasonable conflicts with subsistence activities. The plan would also describe the methods used to monitor the effects of the activity on subsistence use. The plan would be submitted to the BLM Authorized Officer as part of the plan of operations. The plan would address the following items:
i. A detailed description of the activities to take place (including the use of aircraft)
ii. A description of how the applicant would minimize or deal with any potential impacts identified by the BLM Authorized Officer during the consultation process
iii. A detailed description of the monitoring to take place, including process, procedures, personnel involved, and points of contact both at the work site and in the local community
iv. Communication elements to provide information on how the applicant would keep potentially affected individuals and communities up-to-date on the progress of the activities and locations of possible, short-term conflicts (if any) with subsistence activities. Communication methods could include holding community open house meetings, workshops, newsletters, and radio and television announcements.
v. Procedures necessary to facilitate access by subsistence users to conduct their activities
vi. Barge operators requiring a BLM permit are required to demonstrate that barging activities will not have unmitigable adverse impacts on the availability of marine mammals to subsistence hunters.</td><td>in unreasonable interference with subsistence activities. In the event that no agreement is reached between the parties, the BLM Authorized Officer would consult with the directly involved parties and would determine which activities would occur, including the time frames.
b. Applicants would submit documentation of consultation as part of operations plans. Applicants would submit the proposed plan of operations to the North Slope and Eastern Interior Subsistence Advisory Panel for review and comment. Applicants must allow time for the BLM to conduct formal government-to-government consultation with Native Tribal governments if the proposed action requires it.
c. A plan would be developed that shows how the activity, in combination with other activities in the area, would be scheduled and located to prevent unreasonable conflicts with subsistence activities. The plan would also describe the methods used to monitor the effects of the activity on subsistence use. The plan would be submitted to the BLM Authorized Officer as part of the plan of operations. The plan would address the following items:
i. A detailed description of the activities to take place (including the use of aircraft)
ii. A description of how the applicant would minimize or deal with any potential impacts identified by the BLM Authorized Officer during the consultation process
iii. A detailed description of the monitoring to take place, including process, procedures, personnel involved, and points of contact both at the work site and in the local community
iv. Communication elements to provide information on how the applicant would keep potentially affected individuals and communities up-to-date on the progress of the activities and locations of possible, short-term conflicts (if any) with subsistence activities. Communication methods could include holding community open house meetings, workshops, newsletters, and radio and television announcements.
v. Procedures necessary to facilitate access by subsistence users to conduct their activities
vi. Barge operators requiring a BLM permit are required to demonstrate that barging would not have unmitigable adverse impacts on the availability of marine mammals to subsistence hunters.
vii. Operators of all vessels over 50 feet in length engaged in operations requiring a BLM permit must have an automatic identification system transponder system on the vessel.
d. During development, monitoring plans must be established for new</td></tr>
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<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="2">vii. All operators of vessels over 50 feet in length engaged in operations requiring a BLM permit must have an automatic identification system transponder system on the vessel.
d. During development, monitoring plans must be established for new permanent facilities, including pipelines, to assess an appropriate range of potential effects on resources and subsistence, as determined on a case-by-case basis, given the nature and location of the facilities. The scope, intensity, and duration of such plans would be established in consultation with the BLM Authorized Officer and North Slope and Eastern Interior Subsistence Advisory Panels.
e. Permittees who propose transporting facilities, equipment, supplies, or other materials by barge to the Coastal Plain in support of oil and gas activities in the Arctic Refuge would notify, confer, and coordinate with the Alaska Eskimo Whaling Commission, the appropriate local community whaling captains' associations, and the NSB to minimize impacts from the proposed barging on subsistence whaling.</td><td>permanent facilities, including pipelines, to assess an appropriate range of potential effects on resources and subsistence, as determined on a case-by-case basis, given the nature and location of the facilities. The scope, intensity, and duration of such plans would be established in consultation with the BLM Authorized Officer and North Slope and Eastern Interior Subsistence Advisory Panels.
e. Permittees who propose transporting facilities, equipment, supplies, or other materials by barge to the Coastal Plain in support of oil and gas activities in the Arctic Refuge would notify, confer, and coordinate with the Alaska Eskimo Whaling Commission, the appropriate local community whaling captains' associations, and the NSB to minimize impacts on subsistence whaling.</td></tr>
<tr><td colspan="3">H-2 Required Operating Procedure

<u>Objective</u>: Prevent unreasonable conflicts between subsistence activities and seismic exploration.

<u>Requirement/Standard</u>: In addition to the consultation process described in ROP H-1 for permitted activities, before seismic exploration begins, applicants would notify the local search and rescue organizations in proposed seismic survey locations for that operational season. For the purpose of this standard, a potentially affected cabin or campsite is defined as any cabin or campsite used for subsistence purposes and located within the boundary of the area subject to proposed geophysical exploration or within 1 mile of actual or planned travel routes used to supply the seismic operations.
a. Because of the large land area covered by typical geophysical operations and the potential to affect a large number of subsistence users during the exploration season, the permittee/operator would notify all potentially affected subsistence use cabin and campsite users.
b. The official recognized list of subsistence users of cabins and campsites is the NSB's most current inventory of cabins and campsites, which have been identified by the subsistence users' names.
c. A copy of the notification letter, a map of the proposed exploration area, and the list of potentially affected users would also be provided to the office of the appropriate Native Tribal government.
d. The BLM Authorized Officer would prohibit seismic work within 1 mile of any known subsistence use cabin or campsite, unless an alternate agreement between the cabin or campsite owner or user is reached through the consultation process and presented to the BLM Authorized Officer.
e. Each week, the permittee would notify the appropriate local search and rescue of their current operational location within the Coastal Plain. This notification would include a map indicating the current extent of surface use and occupation, as well as areas previously used or occupied during the operation. The purpose of this notification is to give hunters up-to-date information regarding where seismic exploration is occurring and has occurred, so that they can plan their hunting trips and access routes accordingly. A list of the appropriate search and rescue offices to be contacted can be obtained from the coordinator of the North Slope and Eastern Interior Subsistence Advisory Panels in the BLM's Arctic Field Office.</td></tr>
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<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">H-3 Required Operating Procedure

<u>Objective</u>: Minimize impacts on sport hunting and trapping species and to subsistence harvest of those animals.

<u>Requirement/Standard</u>: Hunting and trapping by lessees/operators/contractors are prohibited when persons are on work status. This is defined as the period during which an individual is under the control and supervision of an employer. Work status is terminated when workers' shifts ends, and they return to a public airport or community (e.g., Kaktovik, Utqiagvik, or Deadhorse). Use of operator/permittee facilities, equipment, or transport for personnel access or aid in hunting and trapping is prohibited.</td></tr>
<tr><td colspan="3">ORIENTATION PROGRAMS ASSOCIATED WITH PERMITTED ACTIVITIES</td></tr>
<tr><td colspan="2">I-1 Required Operating Procedure

<u>Objective</u>: Minimize cultural and resource conflicts.

<u>Requirement/Standard</u>: All personnel involved in oil and gas and related activities would be provided with information concerning applicable stipulations, ROPs, standards, and specific types of environmental, social, traditional, and cultural concerns that relate to the region. The operator would ensure that all personnel involved in permitted activities would attend an orientation program at least once a year. The proposed orientation program would be submitted to the BLM Authorized Officer for review and approval and would accomplish the following:
a. Provide sufficient detail to notify personnel of applicable stipulations and ROPs and to inform individuals working on the project of specific types of environmental, social, traditional, and cultural concerns that relate to the region
b. Address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid disturbance, including on the preparation, production, and distribution of information cards on endangered or threatened species
c. Be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel would be operating
d. Include information concerning avoidance of conflicts with subsistence and pertinent mitigation
e. Include information for aircraft personnel concerning subsistence activities and areas and seasons that are particularly sensitive to disturbance by low-flying aircraft; of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose</td><td>I-1 Required Operating Procedure

<u>Objective</u>: Minimize cultural and resource conflicts.

<u>Requirement/Standard</u>: All personnel involved in oil and gas and related activities would be provided with information concerning applicable stipulations, ROPs, standards, and specific types of environmental, social, traditional, and cultural concerns that relate to the region. The operator would ensure that all personnel involved in permitted activities would attend an orientation program at least once a year. The proposed orientation program would be submitted to the BLM Authorized Officer and the Native Village of Kaktovik for review and approval and would accomplish the following:
a. provide sufficient detail to notify personnel of applicable stipulations and ROPs and to inform individuals working on the project of specific types of environmental, social, traditional, and cultural concerns that relate to the region
b. Address the importance of not disturbing archaeological and biological resources and habitats, including threatened, endangered, and sensitive species, fisheries, migratory birds, and marine mammals, and provide guidance on how to avoid disturbance, including on the preparation, production, and distribution of information cards on endangered and/or threatened species
c. Be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel would be operating
d. Include information concerning avoidance of conflicts with subsistence and pertinent mitigation
e. Include information for aircraft personnel concerning subsistence activities and areas and seasons that are particularly sensitive to disturbance by low-flying aircraft; of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall caribou and</td></tr>
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<tr><td colspan="2">hunting and fall caribou and moose hunting seasons, and flights near North Slope communities
f. Provide that individual training is transferable from one facility to another, except for elements of the training specific to a particular site
g. Include on-site records of all personnel who attend the program for so long as the site is active, though not to exceed the 5 most recent years of operations; this record would include the name and dates of attendance of each attendee
h. Include a module discussing bear interaction plans to minimize conflicts between bears and humans
i. Provide a copy of 43 Code of Federal Regulations (CFR) 3163 regarding noncompliance assessment and penalties to on-site personnel
j. Include training designed to ensure strict compliance with local and corporate drug and alcohol policies; this training would be offered to the North Slope Borough Health Department for review and comment
k. Include employee training on how to prevent transmission of communicable diseases, including sexually transmitted diseases, to the local communities; this training would be offered to the North Slope Borough Health Department for review and comment</td><td>moose hunting seasons, and flights near Kaktovik's barrier islands and lagoon waters
f. Provide that individual training is transferable from one facility to another except for elements of the training specific to a particular site
g. Include on-site records of all personnel who attend the program for so long as the site is active, though not to exceed the 5 most recent years of operations. This record would include the name and dates of attendance of each attendee
h. Include a module discussing bear interaction plans to minimize conflicts between polar and grizzly bears and humans
i. Provide a copy of 43 CFR 3163 regarding noncompliance assessment and penalties to on-site personnel
j. Include training designed to ensure strict compliance with local and corporate drug and alcohol policies. This training would be offered to the North Slope Borough Health Department for review and comment
k. Include employee training on how to prevent transmission of communicable diseases, including sexually transmitted diseases, to the local communities; this training would be offered to the North Slope Borough Health Department for review and comment</td></tr>
<tr><td colspan="3">ENDANGERED SPECIES ACT SECTION 7 CONSULTATION</td></tr>
<tr><td colspan="3">Lease Notice. The lease areas may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or to have some other special status. The BLM may require modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activities that would contribute to the need to list such a species or their habitat. The BLM may require modifications to or may disapprove a proposed activity that is likely to adversely affect a proposed or listed endangered species, threatened species, or critical habitat. The BLM would not approve any activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the ESA, as amended (16 USC 1531 et seq.), including completion of any required procedure for conference or consultation.</td></tr>
<tr><td colspan="3">SUMMER VEHICLE TUNDRA ACCESS</td></tr>
<tr><td colspan="3">L-1 Required Operating Procedure

<u>Objective</u>: Protect stream banks and water quality; minimize compaction and displacement of soils; minimize the breakage, abrasion, compaction, or displacement of vegetation; protect cultural and paleontological resources; maintain populations of and adequate habitat for birds, fish, and caribou and other terrestrial mammals; and minimize impacts on subsistence activities.

<u>Requirement/Standard</u>: On a case-by-case basis, the BLM Authorized Officer, in consultation with the USFWS, may permit low-ground-pressure vehicles to travel off gravel pads and roads during times other than those identified in ROP 12. Permission for such use would be granted only after an applicant has completed the following:
a. Submitted studies satisfactory to the BLM Authorized Officer of the impacts on soils and vegetation of the specific low-ground-pressure vehicles to be used; these studies would reflect use of such vehicles under conditions similar to those of the route proposed and would demonstrate that the proposed use would have no more than minimal impacts on soils and vegetation</td></tr>
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b. Submitted surveys satisfactory to the BLM Authorized Officer of subsistence uses of the area as well as of the soils, vegetation, hydrology, wildlife, and fish (and their habitats), paleontological and archaeological resources, and other resources, as required by the BLM Authorized Officer c. Designed or modified the use proposal to minimize impacts to the BLM Authorized Officer's satisfaction; design steps to achieve the objectives and based on the studies and surveys may include timing restrictions (generally it is considered inadvisable to conduct tundra travel before August 1 to protect ground-nesting birds), shifting work to winter, rerouting, and not proceeding when certain wildlife are present or subsistence activities are occurring. At the discretion of the BLM Authorized Officer, the plan for summer tundra vehicle access may be included as part of the spill prevention and response contingency plan required by 40 CFR 112 (Oil Pollution Act).		
GENERAL WILDLIFE AND HABITAT PROTECTION		
M-1 Required Operating Procedure Objective: Minimize disturbance and hindrance of wildlife or alteration of wildlife movements through the Coastal Plain. Requirement/Standard: Chasing wildlife with ground vehicles is prohibited. Particular attention would be given to avoid disturbing caribou.		
M-2 Required Operating Procedure Objective: Prevent the introduction or spread of nonnative, invasive plant species in the Coastal Plain. Requirement/Standard: Certify that all equipment and vehicles intended for use either off or on roads are weed-free before transporting them into the Coastal Plain. Monitor annually along roads for nonnative invasive species and begin effective weed control measures on evidence of their introduction. Before beginning operations in the Coastal Plain, submit a plan for the BLM's approval, detailing the methods for cleaning equipment and vehicles, monitoring for weeds and weed control.		
M-3 Required Operating Procedure Objective: Minimize loss of populations of and habitat for plant species designated as sensitive by the BLM in Alaska. Requirement/Standard: If a development is proposed in an area that provides potential habitat for a BLM sensitive plant species, the development proponent would conduct surveys at appropriate times of the summer season and in appropriate habitats for the sensitive plant species. The results of these surveys would be submitted to the BLM with the application for development.		
M-4 Required Operating Procedure Objective: Minimize loss of individuals o, and habitat for mammalian species designated as sensitive by the BLM in Alaska. Requirement/Standard: If a development is proposed in an area that provides potential habitat for the Alaska tiny shrew, the development proponent would conduct surveys at appropriate times of the year and in appropriate habitats into detect the presence of the shrew. The results of these surveys would be submitted to BLM with the application for development.		

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

2.3.1 No Leasing Alternative

Section 20001 of the Tax Act directs the Secretary of the DOI Secretary to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain. The Tax Act requires that at least two lease sales be held by December 22, 2024, and that each sale offer for lease at least 400,000 acres of the highest hydrocarbon potential lands in the Coastal Plain, allowing for up to 2,000 surface acres of federal land to be covered by production and support facilities. An alternative that would not provide for offer lease sales would be inconsistent with the purpose of this program and, therefore, would be outside its scope.

Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

This chapter combines the description of baseline environmental conditions (Affected Environment) and the analysis of environmental effects (Environmental Consequences) for each resource. Though these two aspects are often in separate chapters in an Environmental Impact Statement (EIS), they are combined here to facilitate continuity for the reader from baseline conditions to potential effects to each resource. Following the description of baseline conditions, the discussion of direct, indirect, and cumulative impacts under each resource provides the scientific and analytic basis for evaluation of the potential effects of each of the alternatives described in **Chapter 2**. Direct and indirect effects to each resource are analyzed in this chapter. Cumulative effects and the potential contribution of the alternatives to the effects of the past, present, and reasonably foreseeable future actions are analyzed in Chapter 4, Cumulative Effects. The approach to impact analysis is discussed further in **Appendix M,** Approach to the Environmental Analysis.

The BLM has relied upon the best available science to inform our consideration of the environmental impacts surrounding an oil and gas leasing program in the Coastal Plain of the Arctic Refuge. However, the nature, abundance, and quality of the data often varies depending upon the action, the geographic region in which it occurs, and the environmental resources that may be affected, and all of these variables influence our understanding of how certain oil and gas exploration and development activities may affect environmental features. When confronted with missing information, this EIS complies with 40 CFR 1502.22

3.2 Physical Environment

3.2.1 Climate and Meteorology

Affected Environment

Climate is generally defined as the most recent 30-year averages of meteorological parameters, such as temperature, precipitation, humidity, and winds; thus climate change is the long-term change in such variables. It can be driven by natural forces, such as volcanic activity, solar output variability, and the earth's orbital variations, or by human forcing, such as land use changes or greenhouse gas (GHG) emissions. Much attention in recent decades has focused on the potential climate change effects of GHGs, especially carbon dioxide (CO_2); it has been increasing in concentration in the global atmosphere since the end of the last ice age. Climate change is rapidly increasing, as the use of fossil fuels has increased in the last 100 years.

The Coastal Plain is within the Arctic National Wildlife Refuge in northeast Alaska, along the Beaufort Sea, which is part of the Arctic Ocean. The area is considered an Arctic Climate Zone with cold winters spanning approximately 8 months of the year (October through May) and cool summers, spanning approximately 4 months of the year (June through September).

Weather data measured at the Kaktovik Airport on Barter Island from late 1947 through mid-2016 are available on the Western Regional Climate Center (WRCC) website under the historical climate data

pages. The period of record climatological data summary for this location is shown in **Table 3.2.1-1** (WRCC 2018a).

Table 3.2.1-1
Period of Record Monthly Climate Summary

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average max. temperature (F)	-7.7	-13.9	-8.8	6.7	26.3	38.4	45.4	43.8	35.4	20.3	5.1	-5.8	15.4
Average min. temperature (F)	-20.3	-26.3	-22.5	-9.3	15.7	30.4	34.8	34.4	27.9	10.1	-6.7	-18.3	4.1
Average total precipitation (in.)	0.48	0.23	0.21	0.19	0.31	0.53	1.03	1.1	0.68	0.77	0.41	0.26	6.19
Average total snowfall (in.)	5	2.7	2.6	2.4	3	1.6	0.5	1.5	4.9	9.2	5	3.4	41.8
Average snow depth (in.)	12	14	15	15	10	2	0	0	1	5	8	10	8

Source: Western Regional Climate Center 2018a. Historical Climate Summaries. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak0558.
Percent of possible observations from September 23, 1947, to June 7, 2016: max. temp.: 98.6%; min. temp.: 99.7%; precipitation: 99.7%; snowfall: 95.7%; snow depth: 98.5%

Based on the Kaktovik climate data, average monthly precipitation in the area is heaviest in July and August, with slightly more than an inch in each of these months. Annual total precipitation averages a little greater than 6 inches. Monthly snowfall is highest in October, with slightly more than 9 inches on average. Snow is typically on the ground for approximately 10 months of the year, with only July and August usually having little or no snow depth. July is the warmest month, with an average maximum temperature around 45°F and an average minimum temperature around 35°F. February is the coldest month, with an average maximum temperature of around -14°F and an average minimum temperature of around -26°F.

Wind speed and direction is measured on Barter Island, at the Kaktovik Airport, as part of the automated weather observing system (AWOS) network; AWOS is operated and controlled by the Federal Aviation Administration (FAA). The Kaktovik AWOS station is near the coast, next to the Coastal Plain area. Using the Iowa State University, Iowa Environmental Mesonet website, the Barter Island wind data for the most recent 10 full years, 2008–2017, were plotted to produce the wind rose in **Figure 3-1** in **Appendix A** (ISU 2018).

The wind rose shows a very strong predominance of winds from the east and the west, with east winds being the most common. Winds from northerly and southerly directions are very infrequent in this area. Average wind speed is also relatively high, which would imply relatively rapid dispersion of any emitted air pollutants most of the time. Calm winds are recorded less than 5 percent of the time.

Wind speed and direction are important to the dilution and transport of air pollutants; wind direction determines where the air pollutants emitted in the area are transported. Based on the Kaktovik wind rose, air pollutants are most often transported in a westerly direction, and secondarily, in an easterly direction. Wind speed affects the concentration of air pollutants. This is because dispersion and turbulence increase with increasing wind speeds, thereby decreasing air pollutant concentrations resulting from an emitted plume of pollutants.

The degree of stability in the atmosphere is also a key factor in the dispersion of emitted pollutants. During stable conditions, vertical movement in the atmosphere is limited and the dispersion of pollutants is inhibited. Conversely, during unstable conditions, upward and downward movement in the atmosphere is enhanced, and dispersion of pollutants in the atmosphere increases. Conditions where temperatures increase with height, known as temperature inversions, can result in very stable conditions, with virtually no vertical air motion. The Coastal Plain area typically experiences more large-scale temperature inversions in the winter than in the summer due to colder stable air masses settling closer to the ground during winter. Summer periods in the program area typically have greater instability due to warming and solar-induced vertical (convective) air currents.

Record climate trends in Alaska, including the North Slope, show a significant uptick in temperatures, mostly occurring as a step change in 1977, when the Pacific decadal oscillation (PDO) changed from a negative phase to a positive phase. The positive phase of the PDO correlates with more southerly winds over Alaska in the winter, leading to positive temperature anomalies.

The only North Slope weather station summarized for temperature trends by the Alaska Climate Research Center (ACRC) is Barrow (now officially renamed Utqiagvik). Temperature records there show an increase in annual average temperature of 6.3°F from 1949 to 2016; a 5.9°F increase has occurred since the PDO shift in 1977. Conversely, the 18 other primary reporting stations distributed throughout Alaska show an average of less than 1.0°F warming since 1977 (ACRC 2018); thus, it is likely that a reduction in ice cover along the north coast of Alaska has had a disproportionate effect on temperature trends since 1977 along the northern coast, compared with the rest of Alaska.

In contrast to temperature, annual average total precipitation shows no discernable trend from 1925 through 2016 in the North Slope climate division of Alaska (WRCC 2018b).

An inventory of recent GHG emissions at various geographic scales is provided in **Table 3.2.1-2**, in units of million metric tons (MMT) per year. Development-related emissions can be compared against these values to provide an estimate of the relative contribution of such emissions at various geographic scales. Note that the emissions in the table do not include sinks that tend to remove some of the emissions from the atmosphere. For example, a significant fraction of CO_2 emitted by human sources each year is taken up by the biosphere, which is gaining mass in response to the emissions.

Table 3.2.1-2
GHG Emissions at Various Geographic Scales in 2015

Geographic Area	Data Source	Annual Emissions (MMT/year)	Percent of Global Emissions
Alaska	ADEC 2018	41.3	0.084
US	EPA 2018	6,638	13.5
Global	Olivier et al. 2017	49,100	100

Direct and Indirect Impacts

This assessment deals primarily with climate, defined as longer-term (30 years or more) variations in meteorological conditions. Any effects of the proposed action on meteorological conditions would be on a very small scale (microscale) and would cover very small portions of the program area, for example, such as a decrease in localized wind speeds and the creation of snowdrifts immediately downwind of structures. Therefore, impacts on meteorological conditions are not addressed further in

this section. Also, the direct and indirect climate and meteorology impacts of the Coastal Plain oil and gas leasing program are generally similar between the action alternatives being considered.

With regard to climate trends and potential effects on the general environment of further changes in the climate of the region, the reader is referred to prior recent NEPA documents, such as the Draft Environmental Impact Statement (DEIS) for the Alpine Satellite Development Plan for the Proposed Greater Moose's Tooth 2 (GMT2) Development Project (BLM 2018). That document provides a discussion of recent (past few decades) trends in Arctic and North Slope climate. Because climate is defined as weather conditions over the most recent three decades, climate conditions and recent climate trends do not differ significantly from those described in the GMT2 DEIS, issued in March 2018, so in general a discussion of climate trends does not need to be repeated here.

With respect to climate change effects of the proposed action, there are two aspects of climate impacts that are addressed below:

1. impacts of the proposed action on climate change (due to emissions of greenhouse gases), and
2. climate change impacts on the proposed action.

Impacts of the Proposed Action on Climate Change

The impacts of the proposed action on the climate could include direct effects occurring at the microscale, due to building structures, and installing combustion sources that can heat localized areas near the development activities. The direct effects would be very small and of little effect on the vast majority of the proposed leasing area.

The indirect effects on climate change would be through GHG emissions that can contribute to a change in the composition of global atmosphere, thereby increasing the so-called greenhouse effect on the planet's heat retention. The GHG emissions that could result from the proposed action would be through combustion of fossil fuels (mainly natural gas, diesel fuel and gasoline) for construction, drilling, production, transport of the petroleum products. There is also a potential for additional GHG emissions from combustion of the products themselves in the global marketplace.

With respect to combustion of the produced petroleum gases and liquids, the project is not large enough to change the supply and demand balance globally. Thus, it is likely that if the proposed action is not taken, the global demand for fossil fuels would remain the same and the demand would be supplied from another production area globally. As a result, there would likely little if any additive effect of combustion of fuels that could be produced due to the proposed leasing action.

Likewise, if the proposed action were not taken, globally there would likely be some other construction, drilling, production and transport-related GHG emissions. However, given the very cold climate conditions of the North Slope, it is expected that GHG emissions from the production and transport activities would be higher, on average, than for the global market as a whole.

To provide a very rough estimate of total GHG emissions from construction, drilling, and production activities of the proposed action (not accounting for the fact that such emissions are likely not entirely additive in a global context), the GMT2 projections for GHG emissions were scaled according to the respect surface areas leased for GMT2, compared with that proposed for the Coastal Plain. For the GMT2 development, total recoverable oil is estimated in the draft EIS at approximately 100 million

barrels (BLM 2018, page 309). For the Coastal Plain, estimated production is estimated to be 100,000 barrels of oil per day (BOPD) for the first year of production, with a decrease of 8 percent per year, until wells are assumed to be shut in when production drops below 4,000 BOPD. This would yield a 40-year production life for the development, yielding total production of 440 million barrels, compared to 100 million barrels for GMT2.

Assuming that GHG emissions are directly proportional to oil production, and using the GMT2 emissions estimates as a basis for scaling the Coastal Plain development emissions, a comparison of estimated oil production and related maximum annual GHG emissions for the Coastal Plain development is provided in **Table 3.2.1-3**. Note that based on the GMT2 DEIS, the estimated GHG emissions vary substantially by year of the development, so the average over an assumed 40-year drilling and production period is used for this analysis. The estimated Coastal Plain development fraction of estimated 2015 global emissions is shown in **Table 3.2.1-4**, along with the percentage of global GHG emissions at the state and US scales. On a global scale, the Coastal Plain drilling and operational emissions represent 0.0001 percent or about one millionth of 2015 global emissions.

Table 3.2.1-3
Projected Oil Production and GHG Emissions Estimates

Development	Total Oil Produced (million barrels)	Avg. Annual GHG Emissions (tons of CO_2e)
GMT2	100	11,693
Coastal Plain	440	51,451

Table 3.2.1-4
GHG Emissions at Various Geographic Scales

Geographic Area	Inventory Year	Data Source	Annual Emissions (MMT/year)	Portion of Global (%)
Coastal Plain	NA	Projected	0.05	0.0001
Alaska	2015	ADEC 2018	41.3	0.084
US	2015	EPA 2018	6,638	13.5
Global	2015	Olivier et al. 2017	49,100	100

Some prior NEPA analyses have used a metric developed by US federal agencies in the past decade, called the social cost of carbon (SCC), to assign a global impact cost per metric ton of CO2e emissions. The SCC metric has been controversial because of some of the subjective aspects involved in making the estimate. Some of these SCC aspects are as follows:

- Selection of a discount rate for the SCC economic impact analysis.
- Scientific basis for construction of models of global “damage estimates” for CO2e emissions.
- Lack of proper accounting of, or ignoring, the beneficial aspects fossil fuel use for global population health and economic prosperity.

Because of the subjective nature of the SCC, it is not used in evaluating impacts from the proposed Coastal Plain oil and gas leasing program.

Impacts of Climate Change on the Proposed Action

The impacts of climate change on the project could include a shorter winter construction season, when the ground and lakes are adequately frozen to support heavy equipment movement. Permafrost is not likely to disappear in the proposed project area during the life of any oil and gas development in the program area. However, if temperatures continue to warm in the area, the warm season active zone (thawed soil zone) will go deeper, making equipment movement more difficult in warm months, and possibly increasing road maintenance frequency and costs. If summer active soil depth increases substantially, allowances would need to be made for more substantial structural supports that rely on permafrost, perhaps requiring deeper anchoring of such supports.

Summer sea ice extent in the Arctic has recovered slightly from lows of past decade, with July 2018 monthly average sea ice extent the highest it has been of any July since 2005, at 9.47 million square kilometers. This is approximately 20 percent lower than the maximum measured July-average Arctic sea ice extent of 11.8 million square kilometers in 1983, and about 12 percent higher than the lowest July extent of 8.47 million square kilometers measured in 2012 (DMI 2018). The period of record for these satellite measurements goes back only to 1979, which is likely near a modern peak in Arctic ice, given the shift in the PDO that occurred in 1977. After 1977 there was a dramatic shift upward in annual mean temperatures in Alaska, along with a decrease in Arctic ice extent. Continued recovery or further declines in Arctic sea ice can have their most significant impacts on temperatures in North Slope coastal areas such as the proposed leasing area. Inland areas are buffered from the moderating effects of open water, so the programarea would be more sensitive to changes in sea ice compared to developments farther inland.

At current rates of sea level rise, from around 7 inches per century (tide gauge record) to 12 inches per century (satellite measurements), it is not expected that sea waters would encroach on any potential development within an approximate 50-year life of production facilities or access roads for the proposed leasing area.

Any further warming of temperatures would tend to further reduce the amounts of fuel used for process heating, as well as for comfort heating of work spaces and living spaces for workers.

Cumulative Impacts

GHG emissions disperse through the global atmosphere relatively quickly relative the time scales of concern for climate, which are decades to centuries. The emissions projection provided above provides a comparison of the project effects in the context of global GHG emissions, which continue to increase due to the cumulative emissions of global industrial development. The potential cumulative climate impacts of this global development have been discussed extensively in the published literature, including several Intergovernmental Panel on Climate Change reports and numerous scientific journals, and therefore, are not repeated here.

3.2.2 Air Quality

Affected Environment

Air quality is measured by the concentration of air pollutants in a geographic area. Wind, temperature, humidity, and geographic features, in addition to natural and anthropogenic emissions sources, are factors that have the potential to affect the resource. Indicators of impacts on air quality are the inability

to meet National Ambient Air Quality Standards (NAAQS) and a degradation of air quality-related values, such as visibility and deposition.

Air Quality

The federal Clean Air Act provides the framework for protecting air quality at the national, state, and local level. The act designates the US Environmental Protection Agency (EPA) as the chief governing body of air resources in the United States; however, it provides states with the management authority to implement their own air quality legislation, monitoring, and control measures. With EPA approval, state and local air districts can implement their own permitting and emission control regulations to implement federal requirements, and the state and local requirements cannot be less stringent than the federal requirements. The Alaska Department of Environmental Conservation (ADEC) is the regulating authority to enforce the Alaska Air Quality Control Regulations under 18 Alaska Administrative Code 50.

Under the authority of the Clean Air Act, the EPA has set time-averaged NAAQS for six criteria air pollutants considered to be key indicators of air quality: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, sulfur dioxide (SO_2), lead, and two categories of particulate matter (less than 10 microns in diameter [PM_{10}] and less than 2.5 microns in diameter [$PM_{2.5}$]) (EPA 2018a). These standards may be updated periodically based on peer-reviewed scientific data. States may set their own ambient air quality standards for criteria pollutants and other pollutants, but their criteria pollutant standards must be at least as stringent as the federal standards. Alaska ambient air quality standards (AAAQS) are the same as the NAAQS, except for the addition of a standard for ammonia. The program area is in attainment or unclassifiable (treated as attainment for regulatory purposes) for each of the NAAQS (EPA 2018b). The nearest nonattainment area is in Fairbanks, approximately 350 miles southwest of the Coastal Plain, which is nonattainment for the $PM_{2.5}$ NAAQS (EPA 2018b).

The Clean Air Act requires each state to identify areas that have ambient air quality in violation of federal standards using monitoring data collected through state and federal monitoring networks. There are no state or federal air quality monitoring stations in or near the program area. Industry monitoring that conforms to EPA guidance is the best available indicator of air quality on the North Slope. There are two monitoring stations that report complete, multiyear data near the program area: BPXA's A-Pad Meteorological and Ambient Air Monitoring Station, approximately 60 miles west of the Coastal Plain boundary, and the ConocoPhillips Alaska, Inc.'s Nuiqsut Ambient Air Quality and Meteorological Monitoring Station, approximately 110 miles west of the Coastal Plain boundary, **Table 3.2.2-1**, below, shows the average pollutant concentrations at each of these stations for the most recent 3 years of verified data (2014–2016) and the percentage of the relevant NAAQS/AAAQS for the 3-year average.

In addition, ADEC reports monitoring values for short-term, project-specific air quality monitors used in the air permitting process. There are nine monitors on the North Slope, including the two described in **Table 3.2.2-1**, from which data have been collected and verified since 2009, usually for 1 year. None of the data from any of these monitors have shown exceedances of the NAAQS/AAAQS (ADEC 2018). Based on the limited oil and gas development activities and the small resident population near the Coastal Plain, it is likely that the baseline air quality pollutant concentrations in the program area are lower than those reported by A-PAD, Nuiqsut, and other monitoring stations on the North Slope.

Table 3.2.2-1
Average Air Pollutant Monitoring Values, 2014-2016

Pollutant	Average Time	A-PAD Monitoring Station Average Background Conc. (2014-2016) [a]	Nuiqsut Monitoring Station Average Background Conc. (2014-2016) [b]	NAAQS/ AAAQS [c]	Percent of NAAQS	
					A-PAD	Nuiqsut
CO	1-hour	—	1,230 μg/m^3	40,000 μg/m^3	—	3
CO	8-hour	—	1,230 μg/m^3	10,000 μg/m^3	—	12
Ozone	8-hour	89.0 μg/m^3	—	140 μg/m^3	64	—
NO_2	1-hour	59.3 μg/m^3	41.9 μg/m^3	188 μg/m^3	32	22
NO_2	Annual	5.2 μg/m^3	3.8 μg/m^3	100 μg/m^3	5	4
SO_2	1-hour	10.4 μg/m^3	5.9 μg/m^3	196 μg/m^3	5	3
SO_2	3-hour	7.5 μg/m^3	6.2 μg/m^3	1,300 μg/m^3	0.6	0.5
SO_2	24-hour [d]	1.8 μg/m^3	4.8 μg/m^3	365 μg/m^3	0.5	1
SO_2	Annual [d]	0.5 μg/m^3	0.003 μg/m^3	—	0.6	—
PM_{10}	24-hour	—	—	150 μg/m^3	—	30
$PM_{2.5}$	24-hour	—	7.3 μg/m^3	35 μg/m^3	—	21
$PM_{2.5}$	Annual	—	2.1 μg/m^3	12 μg/m^3	—	18

Source: [a] ADEC 2018; [b] BLM 2018, [c] Standards converted to micrograms per cubic meter (μg/m^3)

In addition to criteria pollutants, the Clean Air Act regulates toxic air pollutants, or hazardous air pollutants, that are known or suspected to cause cancer or other serious health effects or adverse environmental impacts. The hazardous air pollutant regulatory process identifies specific chemical substances that are potentially hazardous to human health. It sets emission standards to regulate the amount of those substances that can be released by individual facilities or by specific types of equipment. Controls can be required at the source, either through manufacturer requirements, or via add-on control devices, to limit the release of these air toxics into the atmosphere. Hazardous air pollutants most relevant to oil and gas operations are formaldehyde, n-hexane, benzene, toluene, ethylbenzene, and xylenes. There are limited sources for these pollutants on the Coastal Plain.

Visibility

Haze is a form of air pollution that occurs from refraction of sunlight on particles in the atmosphere. The result of haze is impaired visibility. In 1999, the EPA published the Regional Haze Rule, implementing a visibility protection program for certain areas; these are national parks and wilderness areas classified as Class I areas and other federally managed public lands classified as Class II areas. Class II areas under the Regional Haze Rule have less-restrictive visibility requirements, compared with Class I areas. The Class I area nearest to the program area is Denali National Park, which lies about 425 miles southwest. In a NEPA context, analysis is sometimes done to assess potential visibility impacts in federal Class II areas. The nearest federal Class II areas are the Arctic Refuge, in which the Coastal Plain is located, and Gates of the Arctic National Park, approximately 125 miles southwest of the Coastal Plain.

Visibility in some federal Class I and Class II areas is monitored through the Interagency Monitoring for the Protection of Visual Environments (IMPROVE). Visibility is described by two units of measure: haze index in deciviews (dv) and standard visual range. Visibility at Gates of the Arctic National Park (Bettles Field, Alaska) is shown in **Figure 3-2** in **Appendix A** (IMPROVE 2018a). Data collected at the monitor shows a downward trend in haze on the haziest days and essentially constant visibility conditions for the clearest days. The 4 deciview measure on the clearest days corresponds to a visual range of about 160 miles; the approximately 13 to 9 deciviews on the haziest days corresponds to a visual range of 65 to 100 miles (IMPROVE 2018b).

Deposition

In atmospheric deposition, air pollutants are removed from the atmosphere and subsequently deposited in aquatic and land-based ecosystems. This can occur through precipitation or through the dry gravitational settling of particles onto soil, water, and vegetation. A chief concern of atmospheric deposition is the formation of acids, particularly nitrogen and sulfur species. This can happen as acid rain/snow and the subsequent deterioration of lakes, streams, soils, nutrient cycling, and biological diversity. Additional compounds that can accumulate from atmospheric deposition are air toxins, heavy metals (e.g., mercury), and nutrients (e.g., nitrates and ammonium).

Gates of the Arctic National Park, described above under *Visibility*, is the nearest area where nitrogen critical loads have been analyzed and recorded. The critical load ranged between 1 and 3 kilograms per hectare per year (kg/ha/yr), based on 2010 and 2011 estimates, while the maximum nitrogen deposition was 0.94 kg/ha/yr, based on recorded values from 2008 through 2015 (BLM 2018).

The National Acid Deposition Program/National Trends Network measures concentrations and deposition rates of constituents removed from the atmosphere by precipitation (wet deposition). It focuses on those that affect rainfall acidity and those that may cause adverse ecological effects. Trends for ammonium, nitrate, and sulfate ions show that for Gates of the Arctic National Park, recorded deposition is decreasing (BLM 2018, Figures 3.2-4 to 3.2-6).

The Clean Air Status and Trends Network (CASTNET) measures air quality and deposition trends in rural areas. In conjunction with other national monitoring networks, CASTNET data are used to assess relationships between regional pollution and total deposition patterns and to evaluate the effectiveness of national and regional emission control programs. For dry deposition, CASTNET logs flux data from monitoring stations across the country; flux is the rate at which dry particles reach the ground. The nearest monitor with recent data is in Denali National Park. From 1998 through 2016, sulfate ion dry deposition reached its maximum at 2.5 kg/ha-yr in 2006. Nitrate ion dry deposition reached its maximum just below 2.0 kg/ha-yr in 2004, and ammonium ion dry deposition reached its maximum of 1.4 kg/ha-yr in 2004. The annual average trend for all three ion fluxes has been consistent over the period of record for this monitoring station (BLM 2018, Figure 3.2-7).

Air Pollutant Sources

There are few sources of air pollutants in or next to the Coastal Plain. The primary pollutant sources are residential and commercial heating sources and mobile sources, such as snowmachines, vehicles, and aircraft. Additional emission sources on the wider region of the North Slope are oil and gas production facilities, with lesser contributions by electricity generation and waste treatment. As of 2003, there were more than 4,800 exploratory and production wells on Alaska's North Slope (NRC 2003); as of 2018, there were approximately 2.7 million acres of active leases there (Alaska Division of Oil and Gas 2018). There are no active leases or active wells in the Coastal Plain.

Direct and Indirect Impacts

This section describes the potential impacts of the Coastal Plain oil and gas leasing program on air resources. Oil and gas leasing would have no direct impacts on air quality or AQRVs, as it would not authorize any on-the-ground actions. Leasing may lead to indirect impacts because it would authorize lease sales that then would result in on-the-ground activities. These post-lease activities would emit air pollutants from a variety of sources during exploration, development, and production. These pollutants

have the potential to affect air quality and AQRVs on the Coastal Plain and in federal Class II areas such as the Arctic Refuge and Gates of the Arctic National Park.

Alternative A

Under Alternative A, no federal minerals in the program area would be offered for future oil and gas lease sales following the ROD for this EIS. No impacts on air quality or AQRVs from oil and gas development on the Coastal Plain would occur. Local and regional air emission sources, described under Affected Environment, would continue to contribute air pollutants at levels commensurate with the increase or decrease in these emission sources over time.

Impacts Common to All Action Alternatives

Air pollutant emissions and associated impacts on air resources would be similar across all action alternatives. While the locations of facilities would vary by alternative based on the stipulations that would be applied to protect other resources, the overall levels of surface disturbance and well development would be the same across alternatives (**Appendix E**, Reasonably Foreseeable Development [RFD] Scenario). In addition, similar air quality stipulations would be applied across all alternatives (**Chapter 2, Table 2-2**). Where impacts on air quality can be differentiated, these are described under the specific alternative discussions.

The types of air emission sources associated with oil and gas development on the North Slope of Alaska are described in detail in a number of recent studies, including the National Petroleum Reserve-Alaska Final Integrated Activity Plan/EIS (BLM 2012), the air analysis prepared for the Greater Mooses Tooth 2 Development Project Draft Supplemental Environmental Impact Statement (SEIS) (GMT2 SEIS; BLM 2018), and the BOEM Arctic Air Quality Modeling Study reports (BOEM 2014, 2016, 2017). These studies detail the oil and gas development phases and the associated emission sources required during each phase to bring oil and gas resources on the North Slope to production. The types of emissions sources analyzed in those studies are the same as those required to recover oil and gas resources on the Coastal Plain.

As described by these reports, emissions and emission sources would vary based on the phase of development, as summarized below:

- During seismic surveying, emissions would be produced by vibreosis rubber tracked vehicles, helicopters, and bulldozers or larger tracked vehicles used to pull the camp trains. Pollutant emissions would consist primarily of nitrogen oxides and carbon monoxide, with lower levels of other criteria pollutants.
- During exploratory drilling, emissions would be produced mainly by drilling equipment required for exploratory and delineation wells. Additional sources of emissions would be support equipment and vehicles and intermittent activities such as mud degassing and well testing. Pollutant emissions would be dominated by nitrogen oxides, with more moderate levels of volatile organic compounds (VOCs) and carbon monoxide, and lower levels of other criteria and hazardous pollutants.
- During the development phase, emissions would be produced by heavy construction equipment used to construct the central processing facilities (CPFs), satellite well pads, ice roads, and pipelines; well drilling and completion drilling engines/turbines; and support vehicles and aircraft.

The primary emissions would be nitrogen oxides and carbon monoxide, with lesser amounts of VOCs, particulate matter, and sulfur dioxide.

- During the production phase, the primary source of emissions would be power generation for heating, oil pumping, and water injection. The emissions would consist primarily of carbon monoxide and nitrogen oxides, with smaller amounts of particulate matter. There would also be minimal evaporative losses of VOCs from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of nitrogen oxides, VOCs, and possibly sulfur dioxide.

Emissions from seismic surveying and exploratory drilling would be low compared with emissions from development and production. The emissions inventory developed for the BOEM Arctic Air Modeling Study estimated that for all phases of onshore oil and gas development (seismic surveys, exploratory drilling, and development/production), seismic survey operations accounted for less than 1 percent of each type of criteria or hazardous air pollutant emitted, and exploratory drilling accounted for less than 20 percent of VOCs and less than 10 percent of each other type of pollutant emitted (BOEM 2014, Table VI-4). Thus, emissions in the short term would be less than emissions in the long term, assuming that exploration ultimately led to the buildout of oil and gas facilities as described by the RFD (**Appendix E**).

Since the program area is undeveloped, oil and gas resource development would require the construction of a system of ice roads and airstrips to access the CPFs and satellite well pads, as well as construction of the CPFs and satellite pads themselves. This construction would require the development of gravel pits, which are not included in the 2,000-acre surface disturbance cap. Infrastructure and gravel pit development would be sources of localized fugitive particulate matter emissions, both during construction of these features and during use of the roads and operation of the gravel pits.

Because the location, timing, and level of future oil and gas development on the Coastal Plain is unknown at this time, the BLM determined that a qualitative assessment is the appropriate level of analysis for this EIS (BLM undated). Future on-the-ground actions requiring BLM approval, including seismic surveys, exploratory drilling, and specific development proposals, will each require further NEPA analysis based on specific and detailed information about where and what kind of activity is proposed.

Based on the air analyses performed for the National Petroleum Reserve Alaska (NPR-A), GMT2, and BOEM Air Modeling Study (BLM 2012; BLM 2018; BOEM 2016, 2017), the monitoring data reported by ADEC for nine oil and gas development projects on the North Slope (ADEC 2018), the low levels of criteria air pollutants in the ambient air (**Table 3.2.2-1**), and the meteorological conditions of the Coastal Plain described in **Section 3.2.1**, Climate and Meteorology, it is unlikely that a project-specific proposal on the Coastal Plain would exceed an NAAQS/AAAQS or exceed a project-level Prevention of Significant Deterioration (PSD) increment, a critical visibility threshold, or a deposition analysis threshold as determined through project-specific air modeling.

However, because air quality conditions at the time of future project proposals would be different than air quality conditions today and because oil and gas development on the North Slope is expected to increase and contribute to cumulative air quality impacts over time, each project-specific NEPA analysis will require a determination of potential direct, indirect, and cumulative impacts on air quality and

AQRVs. In addition, ADEC would require air emission permits and dispersion modeling to assess impacts of specific facilities in accordance with EPA and Alaska rules and guidance.

Site-specific terms and conditions that may be required prior to authorizing any oil and gas activity will be determined as part of future NEPA analyses and may include one or more of the following as outlined in detail in Required Operating Procedure (ROP) 7 (**Chapter 2**):

- Collecting one year of baseline ambient air modeling prior to initiation of NEPA analysis and air permit application review if no monitoring data are available
- Preparing an emissions inventory to determine pollutants of concern
- Preparing an emissions reduction plan to reduce project-related air emissions, fugitive dust, or greenhouse gases
- Conducting air modeling to analyze direct, indirect, and cumulative impacts
- Implementing mitigation measures and strategies in addition to regulatory requirements if the air quality analysis shows potential future impacts on NAAQS/AAAQS or AQRVs
- Conducting monitoring for the life of the project depending on the magnitude of potential air emissions from the project, proximity to a federal Class II areas, population centers, or other factors
- Modifying activities if monitoring indicates that emissions are causing or contributing to impacts that would cause unnecessary or undue degradation of the lands, cause exceedances of NAAQS, or fail to protect health
- Providing air quality baseline monitoring, emissions inventory, and modeling results to the state, local communities, tribes, and other entities in a timely manner

Alternatives B and C

Impacts under Alternatives B and C would be the same as described under Impacts Common to All Action Alternatives. In addition to Required Operating Procedure 7, under Alternatives B and C all oil and gas operations (vehicles and equipment) that burn diesel fuels must use "ultra-low sulfur" diesel as defined by the Alaska DEC, Division of Air Quality, which would minimize emissions from these sources.

Alternative D

Impacts under Alternative D would be the same as described for Alternatives B and C, with the added measure that to the extent practicable, all oil and gas operations (vehicles and equipment) must be powered by natural gas or electric power rather than diesel fuel. To the extent natural gas and electric power are not practicable, the permittee would use gasoline rather than diesel to the extent practicable. Any vehicles and equipment that require diesel fuel must use ultra-low sulfur diesel as defined by the Alaska DEC, Division of Air Quality. Alternative D would reduce emissions more than the other action alternatives to the extent that this measure was implemented.

Cumulative Impacts

Cumulative effects on air quality and AQRVs over the life of this EIS would result from existing sources of air pollutants in combination with the reasonably foreseeable future actions described in **Appendix M**, Approach to the Environmental Analysis. The cumulative effects analysis area for air quality includes

the North Slope and the federal Class II areas described under Affected Environment, including the Arctic Refuge and Gates of the Arctic National Park. The nearest federal Class I area, Denali National Park and Preserve, is over 425 miles south of the Coastal Plain and is therefore not included in the cumulative effects analysis area.

No quantitative cumulative analysis has been prepared specifically for this EIS. Air analyses prepared for the GMT2 SEIS (BLM 2018) and the BOEM Arctic Air Quality Modeling Study's Photochemical Modeling Report (BOEM 2016) are used to inform the cumulative effects analysis for this EIS, recognizing that these efforts did not include oil and gas development on the Coastal Plain in the modeling of potential cumulative effects on air quality and AQRVs. No such development had been proposed at the time of those analyses.

The methodology for analyzing cumulative effects on air quality in the GMT2 SEIS was described in Section 4.6.5 of that document (BLM 2018). This included evaluating the effects of 14 onshore and offshore oil and gas development sources and the Deadhorse Power Plant. The results were included in Tables 4.6-5 through 4.6-8 in BLM (2018). Cumulative criteria air pollutant concentrations in the Arctic Refuge (Table 4.6-5, BLM 2018) and Gates of the Arctic National Park (Table 4.6-6, BLM 2018) were modeled to be well under the NAAQS/AAAQS. Cumulative visibility impacts were estimated at a change in deciviews of less than 5 dv at the Arctic National Wildlife Refuge and approximately 1 dv at Gates of the Arctic National Park (Table 4.6-7, BLM 2018). Cumulative deposition impacts were estimated at 0.025 kg/ha-yr for nitrogen and 0.006 kg/ha-yr for sulfur at the Arctic Refuge and 0.004 kg/ha-yr for nitrogen and 0.001 kg/ha-yr for sulfur at Gates of the Gates of the Arctic National Park (Table 4.6-8, BLM 2018). As described under the Affected Environment, measured maximum nitrogen deposition was 0.94 kg/ha-yr at Gates of the Arctic National Park; adding the cumulative nitrogen deposition level of 0.004 kg/ha-yr would yield a value of 0.944 kg/ha-yr, which is below the critical load range of 1 to 3 kg/ha-yr. Nitrogen deposition and critical load information for the Arctic Refuge was not available to make a similar calculation.

The BOEM Photochemical Modeling Report (BOEM 2016) evaluated the potential for cumulative effects on air quality and AQRVs from BOEM-authorized offshore oil and gas development along the North Slope in combination with other offshore vessel traffic, onshore oil and gas fields, airports, the Trans-Alaska Pipeline System (TAPS), and onshore non-oil and gas activities such as power plants, stationary fuel combustion sources, on- and off-road mobile sources, waste burning, wastewater treatment, fuel dispensing operations, and road dust (BOEM 2014, Table I-1). The study showed local and regional concentrations of criteria air pollutants below the NAAQS for all pollutants except PM10 and PM2.5. The study showed potential exceedances of the PM10 and PM2.5 NAAQS only in Utqiagvik, approximately 260 miles northwest of the program area boundary at the northern point of the North Slope; these exceedances were attributed to high projected levels of unpaved road dust and sea salt contributions and were reported to not have a high level of certainty because the road dust concentrations were extrapolated from other parts of the state (BOEM 2016, Section 7.1). Modeled visibility impacts from new oil and gas sources showed a change in visibility of 1 deciview or greater on 160 days of the year at the Arctic Refuge's Coastal Plain and on 24 days of the year at Gates of the Arctic National Park (BOEM 2016, Section 7.3, Table 7-4). Deposition levels were modeled above 0.01 kg/ha-yr for nitrogen and sulfur in the Arctic Refuge and above 0.01 kg/ha-yr for nitrogen in the Gates of the Arctic National Park (BOEM 2016, Section 7.3.2, Tables 7-6 to 7-8). Cumulative visibility impacts and deposition levels for all sources included in the BOEM analysis were above thresholds often used to

assess the potential for adverse effect, though these thresholds are for application to a project-specific analysis, not to cumulative impacts of all sources.

As described above, the cumulative analyses for the GMT2 SEIS and the BOEM Arctic Air Quality Modeling Study did not account for proposed oil and gas development in the Coastal Plain, and therefore the potential cumulative effects of the proposed action are not fully known at this time. To assess the cumulative effects of BLM-authorized oil and gas development on the North Slope, the BLM is undertaking its own study, the Cumulative Alaska North Slope Air Quality Regional Model (NS-RAQM). This study will tier off the BOEM study to provide an up-to-date assessment of the potential cumulative effects of North Slope onshore and offshore oil and gas development on air quality and AQRVs in the region.

The BLM anticipates that this study will provide the foundation for being used as a periodically updated modeling analysis. Because it is expected that the growth of oil and gas activities on the North Slope would continue for many years, the model would be updated periodically to reflect actual development rates and locations, allowing the BLM, other federal land managers, and the state to monitor the effects oil and gas development is having on air quality and AQRVs so that appropriate measures can be put in place to minimize the impact on these resources as needed. The modeling study will not be tied to a specific NEPA effort; rather, it will be used to inform future oil and gas-related NEPA analyses on the North Slope.

3.2.3 Acoustic Environment

Affected Environment

This section excerpts the analysis and incorporates by reference the Acoustical Environment section from the Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Plan Supplemental EIS (GMT2; BLM 2018). The GMT2 SEIS can be referenced specifically for its overview of acoustical principles. Because the greater Nuiqsut area, the focus of the GMT2 SEIS, has a different acoustical setting than the Coastal Plain, the 2010 background acoustic monitoring done by the U.S. Armcy Corps of Engineers (USACE) at Point Thomson, next to the western Coastal Plain boundary, is used as a comparable description of existing acoustic environment in the program area (USACE 2012, Appendix O).

Overview

The acoustic environment is the combination of all sounds in a given area. These include natural sounds, such as those caused by wildlife, blowing wind, and running water, as well as unwanted human-caused sounds. The latter are considered noise because they have the potential to affect the natural acoustical environment and noise-sensitive resources and values. In the context of a leasing program, noise-sensitive resources, along with wildlife, are people engaged in subsistence pursuits, recreation, and other activities (BLM 2018).

The degree to which noise may disturb wildlife and human receptors depends on many factors, such as the following (Francis and Barber 2013 in BLM 2018):

- Wildlife responses to noise are known to vary by species
- Acoustical factors, such as the frequency, intensity (loudness), and duration of noise

- Non-acoustical factors, such as life-history stage, environmental or behavioral context, and degree of past exposure

Noise that is abrupt and unpredictable may be perceived as a threat, potentially triggering a startle response or antipredator behavior (Frid and Dill 2002; Francis and Barber 2013 in BLM 2018). Chronic noise may affect sensory capabilities via masking of biologically important natural sounds, such as those used for communication or detection of predators or prey (Francis and Barber 2013). Similarly, human responses to noise also are contingent both on acoustical and non-acoustical factors. Examples of the latter are social context and perceived ability to exert control over the noise source (Kroesen et al. 2008; Stallen 1999 in BLM 2018).

The spread (propagation) of sound in outdoor settings is affected by many variables: distance from the source; meteorological conditions, such as temperature, wind, and humidity; and landscape features and surface characteristics that may interfere with sound through absorption, reflection, or diffraction (Attenborough 2014 in BLM 2018).

Among these, distance is the most significant factor. For a point source producing a constant sound, sound levels are expressed as decibels (dB) and generally decrease (attenuate) by approximately 6 dB for each doubling of distance from the source. The same 6 dB attenuation with doubling distance holds for the maximum sound level produced by a single moving source, such as an aircraft in flight, when the source is at its closest point of approach to the receptor (Attenborough 2014 in BLM 2018). For a line of moving sources, such as vehicle traffic on a road, sound levels decrease by approximately 3 dB with doubling distance.

When wind is present, sound attenuation with distance is less than expected in the downwind direction—downwind propagation is enhanced—and greater than expected in the upwind direction. Temperature inversions reduce attenuation and enhance propagation. In general, meteorological conditions tend to enhance sound levels to a lesser degree, such as 1 to 5 dB, than they attenuate sound levels, such as 5 to 20 dB (Attenborough 2014 in BLM 2018).

Existing noise sources in the Coastal Plain area are the following:

- On-road and off-road vehicles and snowmobiles and community noise, such as generators and other small equipment motors, in the village of Kaktovik
- On-road and off-road vehicles and snowmobiles used for subsistence activities and travel between villages and subsistence camps
- Motorboats
- Aircraft in Kaktovik
- Tourism aircraft in the Arctic Refuge
- Aircraft and boats in the region used for recreationists and scientific researchers

Passive Acoustic Monitoring

The USACE conducted baseline acoustical monitoring in 2010 approximately 9 miles inland from the coast and 3 miles west of the Canning River. In this area, noise from human activities was generally absent (USACE 2012). Those conducting the baseline monitoring recorded hourly median sound levels

of 23 to 28 dBA during winter conditions (April 27–June 8) and 24 to 26 dBA during summer conditions (July 12–August 12).

The Coastal Plain program area is expected to have an acoustic environment similar to that described by the USACE in its acoustical assessment (2012). In that study the USACE noted that the low levels of sound recorded across all hours of the day, and across different seasons of the year, show loud events are rare. Natural sources, such as wildlife and wind, were the dominant sound of the sampling areas in the soundscape in both winter and summer. The USACE (2012) observed that human-caused noise, dominated by aircraft, ranged from zero to one event per hour (see also **Section 3.4.9,** Transportation)

Direct and Indirect Impacts

Impacts from noise are characterized by their effects on wildlife and the human environment. Impacts are most concentrated in places that are highly populated, highly sensitive to sound, or of disproportionate importance to people or wildlife. The village of Kaktovik is the only permanent settlement adjacent to the program area, though the broader coastal plain is used for a variety of subsistence activities, most notably hunting. The program area provides habitat for a number of species that are particularly susceptible to noise disturbance, including polar bears, especially during denning; caribou, especially during calving and post-calving activities; and migratory birds, especially during breeding and brood-rearing activities. Noise impacts specific to wildlife and subsistence users are analyzed more fully in those resource sections.

Methods of estimating noise impacts described in the GMT2 analysis (BLM 2018) are applicable to this EIS. In evaluating potential impacts of project-related noise, it is necessary to consider noise levels in relation to existing ambient sound levels at the location of the receptor. The effects of project-related noise on overall noise levels and the relative audibility of project noise are dependent on the ambient sound level that exists at the location of the receptor:

- Project noise that is 10 or more dBA below the existing ambient sound level likely would be inaudible to the human ear.
- Noise that is approximately equal to existing ambient sound level would only be marginally or slightly audible, depending on the hearing capabilities of the individual receptor.
- Project noise that is 10 dBA or greater above existing ambient would become the dominant element of the acoustical environment.
- Project noise with a level of 40 dBA would be readily audible in a setting with an existing ambient sound level of 35 dBA or less, but likely would be inaudible in a setting where the existing ambient sound level is 50 dBA or more.

Alternative A

Under Alternative A, no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales and no changes would occur to the ambient noise environment as a result of oil and gas development on the Coastal Plain. Alternative A would have direct or indirect impacts on the acoustic environment related to aircraft, and would retain background noise levels, which include the effect of noise generated by approximately nine flights per day from the Kaktovik Airport.

Impacts Common to All Action Alternatives

The primary noise sources associated with oil and gas development would be ground-based equipment and aircraft.

Ground-based Equipment

Sources of noise associated with fluid mineral development are construction, operation, and support activities for oil and gas wells. Construction activities contribute shorter-term, temporary noises associated with the initial development of oil and gas infrastructure. This includes the construction of new roads, the use of vehicles and equipment to construct wells, and the drilling of wells.

Median noise levels of drill rigs at 1,000 feet is estimated to be 52 dB, and maximum noise levels are estimated to be 84.4 dB. In a 35 dB ambient sound level, representative of the program area, both would be high-impact, dominant sounds. At a 50 dB ambient sound level, representative of developed coastal areas, the median noise levels would be marginally audible, but maximum sound levels would still be dominant. Assuming an attenuation rate of 6 dB per doubling of distance, sounds from onshore drilling 6 miles away would be below 24 dB at their median level. This median noise level would be inaudible in a 35 dB ambient sound level, but maximum noise levels would be audible and dominant from 6 miles away at that same ambient noise level.

Leasing availability extends to within 1,000 feet of the village of Kaktovik, with allowable leasing in Kaktovik lagoon. Onshore leasing availability is nearest to the village at a point approximately 6 miles south of Kaktovik. Offshore lease availability would be subject to controlled surface use (CSU) under Alternative D, and subject to timing limitations under Alternatives B and C. Timing limitations would seasonally limit noise disturbance to the community. Nearby onshore areas available for leasing would be subject to standard terms under all alternatives and would therefore have similar effects.

Alternatives C and D, which preclude sale of oil and gas leases in a southeastern portion of the Coastal Plain, would have fewer noise-related impacts than Alternative B, which opens the area with general stipulations on use. Under Alternatives C and D, the only noise impacts to the lands closed to lease sale would be the potential noise intrusions from adjacent lands and potential increases in air traffic. In addition, Alternative D includes the largest proportion of lands with NSO designations, which would limit surface occupancy, and thus limit sounds associated with drilling.

Aircraft

Kaktovik Airport is approximately 1 mile from the village Kaktovik and is the nearest and most central airport to the program area. The amount of air traffic through Kaktovik and routing of aircraft through the region could be strongly influenced by the construction of additional air strips within the program area. It is difficult to estimate the magnitude of aircraft use that will result from enabling fluid mineral activity on the Coastal Plain; the rate of development and potential use of ships or vehicles on new roads are two key uncertainties that would affect air traffic.

A highly conservative estimate of the level of air traffic related to oil and gas activities in the region is represented by Deadhorse Airport, which serves as the primary hub for oil and gas activities on the North Slope of Alaska. Airport Master Records for this airport, which provides key air connections to Fairbanks and Anchorage, report a 12-month average of 91 flights per day, relative to Kaktovik Airport's average of 9 flights per day (ARM 2016). This is consistent with the 2010 noise analysis that reported

aircraft noise levels on the order of one event per hour in the eastern Coastal Plain (USACE 2011, Section 5.20.8).

The noise attenuation estimates tabulated as part of the GMT2 analysis (BLM 2018, Table 4.1-45) suggest that air traffic could be discernable 5 to 10 miles from the source for the loudest aircraft routinely operating in the region (based on a background noise level of 35 dB). At a higher ambient noise level (50 dB), more typical of the environment and villages west of the Arctic Refuge, this distance can reduce to 1 to 2.5 miles. Based on the most conservative estimate of noise multiplied over the 50-mile distance between Deadhorse and the border of the program area, approximately 320,000 acres could be subject to a greater frequency of audible aircraft noise. The extent to which flights are routed from Fairbanks, or routed further north between Deadhorse and Kaktovik, could significantly alter the location, number, and intensity of affected acres. These impacts would be similar across alternatives.

Because of the proximity of Kaktovik Airport to the community of Kaktovik, there is a potential for high, localized impacts to the acoustic environment of the community, with impacts commensurate with use of the airport. Take-offs and landings at the airport are audible and dominant sounds in Kaktovik. The different action alternatives do not present a clear basis for differences in use of the airport, so use levels are estimated to be the same among them. These use levels could be up to ten times current use levels if air traffic levels at the Deadhorse Airport are indicative of future air traffic levels at Kaktovik Airport. Although measures to manage aircraft type could influence the noise levels experienced by the community, even quieter aircraft dominate the soundscape at 1 mile under 35 dB background noise conditions. At a 50 dB level, there is an appreciable difference in audibility of noises in the 45 to 60 dB range.

Cumulative Impacts

Fluid mineral activities would add to existing impacts on acoustic resources on the North Slope, namely those caused by activities in the NPR-A, activities on state lands located on the Prudhoe Bay Oil Field, and offshore drilling activities. Oil and gas activities on the North Slope result in localized, but additive impacts on the acoustic environment from drilling operations and air traffic levels in the region, whose reach extends at least 50 miles from any standard connection route. Existing and projected air traffic has the greatest potential for cumulative impact by increasing the number of flights over an area per day.

3.2.4 Physiography

Affected Environment

Physiography describes the physical features of an area, including landforms and topography. The Coastal Plain of the Arctic Refuge occupies about 1.6 million acres in the northeast corner of Alaska. It stretches about 100 miles from the Staines River, the westernmost distributary of the Canning River, on the west to the Aichilik River on the east. From the coast of the Beaufort Sea, the Coastal Plain extends south about 40 miles at its widest point. Elevations range from sea level along the coast to about 1,000 feet at the southern boundary. The Coastal Plain is drained by braided channel rivers, which have their headwaters in highlands to the south. These sediment-laden rivers form deltas where they flow into the sea.

A physiographic province is a region of similar topography and climate that has had a unified geomorphic history. The Coastal Plain encompasses parts of three physiographic provinces, as defined by Wahrhaftig

(1965). These provinces, shown on **Map 3-1, Physiographic Provinces** in **Appendix A**, consist of the Arctic Coastal Plain, the Arctic Foothills, and the Arctic Mountains.

Arctic Coastal Plain

Ninety percent of the Coastal Plain is in the Arctic Coastal Plain physiographic province, a smooth plain rising gradually from the Beaufort Sea to a maximum elevation of 600 feet above sea level (asl). The coastline has low relief and the shore is typically only 1 to 10 feet above the sea (Wahrhaftig 1965). Coastal cliffs in the Coastal Plain of the Arctic Refuge have a maximum height of 25 feet (Clough et al. 1987, p. 9).

The Arctic Coastal Plain province is divided into the Teshekpuk (1a) and White Hills (1b) sections. The Teshekpuk section is flat and covered with elongated thaw lakes that are all oriented in a similar direction on the landscape. The White Hills section is characterized by scattered groups of low hills rising above the plain. The northwest corner of the Coastal Plain is part of the Teshekpuk section, and the remainder of the Arctic Coastal Plain physiographic province in the Coastal Plain belongs to the White Hills section (Wahrhaftig 1965).

Much of the Arctic Coastal Plain is dominated by a series of large alluvial fans (USFWS 2015, p. 4-17); these are horizontal triangular deposits that form where streams flow onto a level plain from a region of higher slopes.

The Arctic Coastal Plain province is underlain by permafrost that extends to depths of over 1,000 feet (Wahrhaftig 1965). Permafrost is the thickness of subsurface material, such as, soil, rock, minerals, interstitial and segregated ice, or organic matter, in which the temperature has been continuously below 32 degrees Fahrenheit. Although permafrost is generally considered to be perennially frozen ground, it is not always frozen hard. In some cases, elevated salinity or the presence of liquid hydrocarbons can depress the freezing point (Clough et al. 1987).

Permafrost is covered by a surface "active layer," which freezes and thaws annually. The thickness of the active layer in the Coastal Plain ranges from less than 1 foot to 5 feet and averages about 2 feet (Brewer 1987). A year-round thawed layer, termed a "thaw bulb," may be present beneath lakes 7 feet deep or greater or beneath some parts of deeper rivers, such as the Canning. Based on studies of seawater and borehole temperatures, the permafrost layer in the nearshore area of the Beaufort Sea probably extends out to water depths of 500 feet (Brewer 1987).

A number of topographic features are associated with permafrost, the most prominent of which are ice-wedge polygons (Wahrhaftig 1965). These are vertical wedge-shaped veins of ice that develop in thermal-contraction cracks. These cracks form in a pattern of interconnected polygons that can vary in size. Most range from 30 to 200 feet in diameter and are visible at the surface, although some in the southern part of the Coastal Plain are masked by tussock-type tundra (Brewer 1987). Most polygonal areas in the Coastal Plain have low-centered polygons with raised ridges at their outer edges (Brewer 1987).

Other features associated with permafrost that can be found in the Coastal Plain are as follows:

- Beaded streams—series of small ponds connected by minor streams
- Frost boils—upwellings of mud that result in barren and partially vegetated areas

- Pingos—low, ice-cored mounds formed as soil-covered water freezes and expands upward

Permafrost is described in greater detail in **Section 3.2.8**, Soil Resources.

Arctic Foothills

Most of the southern edge of the Coastal Plain is in the northern section (2a) of the Arctic Foothills physiographic province, as shown on **Map 3-1, Physiographic Provinces** in **Appendix A**. This province consists of rolling plateaus and low, east-trending linear mountains. Elevations in the northern section of the Arctic Foothills province range from about 600 feet asl on the north to 1,200 feet asl on the south. Like the Arctic Coastal Plain province, the Arctic Foothills province is underlain by thick permafrost and has many of the same permafrost features described above: thaw lakes, polygonal ground, and beaded stream drainages. Other ice-related features in the Arctic Foothills are gelifluction lobes[1] and stone stripes, consisting of lines of stones that form through frost heaves (Wahrhaftig 1965; USFWS 2015, p. 4-17).

Arctic Mountains

About 28,000 acres, or less than 2 percent, of the Coastal Plain along the southern border is in the Central and Eastern Brooks Range section of the Arctic Mountains physiographic province (see **Map 3-1, Physiographic Provinces** in **Appendix A**). The Central and Eastern Brooks Range consists of rugged east-trending ridges reaching elevations of 7,000 to 8,000 feet asl. The mountains in the Brooks Range typically have cliff-and-bench slopes formed by glacial erosion of bedded rocks (Wahrhaftig 1965).

Beaufort Sea Coast

The Coastal Plain extends outward from the coastline to the Arctic Refuge boundary, which includes tidally influenced areas of the Beaufort Sea. The Beaufort Sea coast is not identified as a separate physiographic province, but it is an integral part of the Coastal Plain, with distinct physical features. The Beaufort Sea coastline is irregular, with narrow beaches and small tides. It is characterized by numerous deltas, points, offshore shoals, mudflats, spits, bars, low-lying barrier islands, and shallow lagoons. The most pronounced deltas are associated with the Canning, Hulahula-Okpilak, Jago, and Aichilik Rivers (Clough et al. 1987). Rivers of the Coastal Plain are discussed in **Section 3.2.10**, Water Resources.

Coastal bluffs are typically 4 to 5 feet high but, as noted above, can be as high as 25 feet. The highest elevation along the coast is at 3-mile-wide Barter Island, which is more than 50 feet. Lagoons and bays are generally only 3 to 12 feet deep, except for Camden Bay where depths are greater than 15 feet (Clough et al. 1987, p. 9). Camden Bay extends across more than half of the Coastal Plain coastline and is the largest single feature. The Beaufort Sea coastline is gradually receding. Coastal erosion, one factor that can contribute to a receding coastline, is discussed under geologic hazards in **Section 3.2.5**, Geology and Minerals.

Direct and Indirect Impacts

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015). Changes to

[1] Tongue-shaped deposits formed from slow flows of the active layer on slopes of 5 to 20 degrees

physiographic features, such as geomorphic features formed by coastal erosion and deposition or mass movement, would continue to occur along current trends.

Impacts Common to All Action Alternatives

Construction of project infrastructure would affect topography in the program area and could result in reshaping of geomorphological features such as waterbodies and permafrost features.

All of the action alternatives would require placement of gravel fill, which would have the direct impact of altering the topography within the development footprint. Gravel infrastructure would include pads, roads, and an airstrip as described in **Chapter 2**. This long term impact would begin during the construction phase and last throughout the development phase until the gravel is removed during reclamation. Impacts would last longer if not all gravel infrastructure (e.g., access roads) is removed.

In addition to the direct effects on topography that would result from placement of gravel fill, the presence of gravel infrastructure would alter existing geomorphic features. For example, the sea barge landing and staging structures would affect the pattern of sediment erosion and deposition which could result in local changes to the coastline configuration. This impact would be short term (lasting less than five years) because the structures would be removed after they are no longer needed for the construction phase. Likewise, if the gravel pad for the seawater treatment plant was placed in water rather than on land, similar effects to physiography would occur. However, this impact would be long term, lasting throughout the development phase and for some period after the structure is removed during reclamation. Other gravel infrastructure could affect permafrost features or result in changes to stream or lake morphology. Direct and indirect impacts on permafrost features are further described in **Section 3.2.8,** Soil Resources. Direct and indirect impacts on surface water features are further described in **Section 3.2.10,** Water Resources.

All action alternatives assume a surface disturbance area of approximately 2,000 acres, not including the gravel pits. Most, but not all, of the surface disturbance is associated with placement of gravel fill. The size of the seawater treatment plant would be an estimated 15 acres under all action alternatives. For the sea barge landing, each action alternative assumes a 10-acre gravel pad for staging modular units adjacent to a landing at Camden Bay and a 5-acre pad at a landing along the eastern coast of the Coastal Plain. The footprint of other gravel infrastructure would vary depending on the alternative (see discussion of each alternative below).

All of the action alternatives would include development of a gravel mine or mines, which would also result in direct long term impacts on topography. Impacts of gravel mining on physiography would last beyond the development phase because the pits remaining from gravel extraction would typically not be completely backfilled and any remaining depression could fill with water and become a permanent lake. Gravel mines are described further in **Section 3.2.9,** Sand and Gravel Resources. Gravel mine sizes would vary depending on the alternative (see discussion of each alternative below).

Ice infrastructure (e.g., pads and roads) would have negligible impacts on topography but could affect permafrost and surface water geomorphic features as discussed further in **Section 3.2.8,** Soil Resources and **Section 3.2.10,** Water Resources.

Potential changes to physiography associated with geologic hazards (e.g., subsidence or slope failure) are addressed in **Section 3.2.4 Geology and Minerals**.

Alternative B

Estimated acreages associated with gravel infrastructure and gravel mining specific to Alternative B include:

- Approximately 228 acres of surface disturbance from 19 drill pads
- Approximately 100 to 150 acres of surface disturbance from three CPFs
- Approximately 1,643 acres of surface disturbance from gravel roads
- Assuming a 50-foot pit depth, the gravel pits to supply gravel needs would be approximately 155 acres, and a 25-foot pit depth would require approximately 310 acres.

Alternative C

Estimated acreages associated with gravel infrastructure and gravel mining specific to Alternative C include:

- Approximately 228 acres of surface disturbance from 19 drill pads
- Approximately 100 to 150 acres of surface disturbance from three CPFs
- Approximately 1,590 acres of surface disturbance from gravel roads
- Assuming a 50-foot pit depth, the gravel pits to supply gravel needs would be approximately 158 acres, and a 25-foot pit depth would require approximately 315 acres.

Alternative D

Estimated acreages associated with gravel infrastructure and gravel mining specific to Alternative D include:

- Approximately 235 total acres of surface disturbance from 20 drill pads
- Approximately 100 acres of surface disturbance from two CPFs
- Approximately 1,630 acres of surface disturbance from gravel roads
- Assuming a 50-foot pit depth, the gravel pits to supply gravel needs would be approximately 154 acres, and a 25-foot pit depth would require approximately 308 acres.

Cumulative Impacts

Impacts on topography and geomorphic features resulting from gravel infrastructure are generally localized to the footprint or adjacent area. Therefore the geographic area relevant for assessing cumulative impacts on physiography is the program area. While other past, present, and reasonably foreseeable future actions on the North Slope (**Appendix M**, Approach to the Environmental Analysis) have had or would have impacts on physiography, none of these would be in the program area and so would not contribute to cumulative impacts on physiographic features in the Coastal Plain.

Climate variability would not have a measurable effect on overall topography within the timeframe of the leasing and development activities proposed in this EIS; however, changes to the coast may occur as a result of climate warming. The general warming of the Arctic appears to have lengthened the open-water period in the Beaufort Sea (USACE 2012, Ch. 5). A longer open-water period allows for longer exposure of beaches to coastal processes and increases the fetch for generation of larger sea waves.

These factors combine to produce more rapid coastal erosion and shoreline retreat, especially at locations not protected by barrier islands.

Climate variability effects on permafrost and surface water geomorphic features are addressed in **Section 3.2.8,** Soil Resources and **Section 3.2.10,** Water Resources.

3.2.5 Geology and Minerals

Affected Environment

Geology

The Coastal Plain is in the eastern part of the North Slope geologic province and has greater geologic complexity than that found elsewhere in northern Alaska. The North Slope geologic province is part of a tectonic feature referred to as the Arctic Alaska microplate. The geologic history for this continental microplate includes three primary tectonic settings: a south-facing passive continental margin during the Devonian to Triassic, a northern rifted margin in the Jurassic to Early Cretaceous, and a southern orogenic[2] margin, with a related foreland basin and fold-and-thrust belt from the Jurassic to recent time (Bird 1999).

A thin layer of surficial deposits covers the bedrock geology in most of the Coastal Plain; therefore, information and understanding of the bedrock geology has been obtained primarily from geophysical remote sensing, observations in the mountains south of the area, and wells drilled west and north of the area (Bird 1999).

Four tectono-stratigraphic sequences characterize the Northern Alaska geologic province (see **Figure 3-3** in **Appendix A**). The oldest sequence is the Franklinian, which consists of a thick succession of metamorphosed sedimentary, volcanic, and igneous rocks of Proterozoic to Early Devonian age. The overlying Ellesmerian sequence of Middle Devonian to Triassic age rocks represents the south-facing passive margin referred to above. The Beaufortian sequence records the Jurassic and Cretaceous rifting, which severed the continental connection of northern Alaska and opened the Canada basin. The Brookian sequence, Jurassic to recent age, consists of sediments originating from the ancestral and modern Brooks Range and deposited in foreland basin and passive margin settings (Bird 1999). Information regarding the oil potential for these sequences is provided in **Section 3.2.7**, Petroleum Resources.

Geologic structures in the Coastal Plain consist of closely spaced folds and faults in rocks that were deposited in the foreland basin setting and broad, domal faulted structures in the pre-foreland basin and basement rocks. These structures formed in one or more episodes of Brooks Range-related deformation during Cenozoic time. Devonian and possibly older structures are also present in the Coastal Plain, and these structures have controlled the orientation of some younger Cenozoic structures (Bird 1999).

A major structural feature of the Coastal Plain is the east-northeast trending Marsh Creek anticline, which formed during the Oligocene (Bird 1999). Rather than being a simple anticline, the Marsh Creek anticline is interpreted to be either a triangle zone or an anticlinorium[3] (Bird and Magoon 1987). The

[2] Mountain building
[3] An intensely deformed series of anticlines and synclines that together form a general arch

Marsh Creek anticline divides the Coastal Plain into two areas having different structural characteristics. Rocks northwest of the Marsh Creek anticline are in the "undeformed area" and have remained nearly undeformed since their deposition. Rocks to the southwest of the Marsh Creek anticline, the "deformed area," have been thrust faulted, folded, and uplifted (Magoon et al. 1987). The deformed area is about twice the size of the undeformed area.

Figure 3-4 in **Appendix A** is a geologic map of the Coastal Plain. The plain is largely covered by a thin mantel of Quaternary unconsolidated sediments that range in thickness from a few feet to about 100 feet (Clough et al. 1987). These include river deposits (alluvium), beach deposits, colluvium, alluvial fans, terrace deposits, marine terrace deposits, glacial deposits, glaciofluvial deposits, and landslides (Marshall et al. 1998). Only about 10 percent of the Coastal Plain was glaciated during the Pleistocene. In the southwest corner, a large valley glacier extended northeastward approximately 12 miles into the area for approximately 7 miles along the Tamayariak River. Smaller valley glaciers extended about 4 miles into the area along the Hulahula River, just across the Coastal Plain boundary along the Jago River, and 2 miles along the Aichilik River. Glaciofluvial deposits and eolian[4] materials are widespread, even in unglaciated areas (Clough et al. 1987).

As shown in **Figure 3-4** (**Appendix A**), two types of surficial deposits predominate in the Coastal Plain: "gravel and sand" and "silt and very fine sand over gravel." Gravel and sand include deposits associated with river floodplains and terraces and upland terraces that lack a silt cover. Silt and very fine sand over gravel comprise a fine-grained cover, generally more than 6.6 to 10 feet thick and ice rich, and commonly containing fine-grained organic debris. Morainal deposits composed of compact, silty, bouldery till are present in the previously glaciated areas along the southern border of the Coastal Plain. Near the coast, surficial unconsolidated deposits typically consist of alluvial sediments (silt, sand, and gravel) overlying finer grained marine sediments.

The cover of unconsolidated sediments is broken up by outcrops of Tertiary-Cretaceous sedimentary rocks. The largest of these outcrop areas occur along the Marsh Creek anticline and upper Jago River. Outcrops in the Marsh Creek anticline area include the Sagavanirktok and Canning Formations (Marshall et al. 1998). The Sagavanirktok Formation consists of poorly consolidated gray siltstone, mudstone, sandstone, and lesser amounts of conglomerate that were deposited in non-marine and shallow marine environments. This rock unit is as much as 4,900 feet thick on the north flank of the Marsh Creek anticline and 7,500 feet thick in wells near the mouth of Canning River. The Canning Formation consists of gray shale and siltstone containing interbeds of mostly thin-bedded, very fine to fine-grained lithic sandstone that represent turbidites deposited in a deep-water marine environment. The Canning Formation was measured at 4,900 to 5,000 feet thick in wells west of Canning River.

The Jago River Formation crops out in the upper Jago River area (Marshall et al. 1998). This formation consists of well hardened, thick-bedded, fine- to coarse-grained, lithic sandstone and conglomerate. There are also minor amounts of coal and carbonaceous shale deposited in a primarily non-marine with minor shallow marine environment. The Jago River Formation is 9,800 feet thick in its type section along Igilatvik (Sabbath) Creek.

[4] Windblown

Smaller bedrock outcrops occur around the Sadlerochit Mountains and in the east-central part of the Coastal Plain. In addition to the Canning Formation, these outcrops are the Cretaceous Hue Shale, Pebble Shale unit, and Kemick Sandstone; Cretaceous-Jurassic Kingak Shale; Triassic Karen Creek Sandstone; and Pennsylvanian-Mississippian Lisburne Group (Marshall et al. 1998).

For more detailed information regarding the rock units and geologic structure of the Coastal Plain, refer to Bird and Magoon (1987) and Bird (1999).

Geologic Hazards

Geologic hazards are natural physical conditions that could damage land or structures and injure humans. Potential geologic hazards in the Coastal Plain are earthquakes, surface faults, landslides, land subsidence, flooding, sea ice ride-up and override, coastal erosion, and storm surge.

<u>Earthquakes and Surface Faults</u>

The USGS has prepared seismic hazard maps for Alaska that portray the probability of ground motion (peak ground acceleration) due to an earthquake (USGS and ADNR 2006). For the Coastal Plain, the USGS estimates that peak ground accelerations of up to 0.2 g (where g equals the acceleration due to gravity); there is a 5 percent probability that this acceleration will be exceeded in 50 years; thus, the Coastal Plain is in an area of relatively low seismic risk.

Historically the level of earthquake activity in the Coastal Plain is low. Earthquakes of magnitude (M) 6 and larger on the Richter scale of intensity are potentially destructive; earthquakes of M 5 could cause local damage (Clough et al 1987). Epicenters of five earthquakes with M 4.5 to M 5.0 have been recorded in or within 15 miles of the Coastal Plain (USGS 2018a). Of these, three were centered in the Coastal Plain: an M 4.7 earthquake in February 2006 and M 4.5 and M 4.9 earthquakes in April 2007. Three earthquakes above M 5.0 have been recorded in the northeast corner of Alaska, the closest of which was an M 5.2 earthquake centered about 30 miles southwest of the Coastal Plain in August 1995. The largest of the three was an M 5.5 earthquake in August 2003 about 80 miles from the southwest corner of the Coastal Plain (USGS 2018a).

The USGS's Quaternary fault and fold database (USGS and ADNR 2006) contains information on faults and associated folds in the United States that are believed to be sources of earthquakes greater than M 6 during the Quaternary (i.e., the past 1,600,000 years). This database indicates the presence of one Quaternary surface feature in the Coastal Plain, which is the Marsh Creek anticline (described above and depicted on **Map E-1, Hydrocarbon Potential** in **Appendix E**). A group of several faults, known as the Camden faults or Camden fault zone, is offshore. The closest of these faults is about 10 miles from the coast. The most recent deformation on the Camden faults is less than 15,000 years old.

<u>Slope Failure</u>

Slope failure in the Coastal Plain can occur in the form of solifluction[5] and creep or slump along coastal bluffs, terrace escarpments, lake margins, and ridge slopes. Locally along a stretch of the Katakturuk River and near Marsh and Carter Creeks, landslides have occurred in weathered and soft Tertiary shale, siltstone, and sandstone. In all areas having any appreciable slope and exposed mineral soil, the soil

[5] Very slow deformation of the seasonally thawed surface forming elongated shallow lobes

migrates gradually downslope because of seasonal frostjacking of individual soil grains (Clough et al. 1987).

Retrogressive thaw slumps are slope failures resulting from thawing, ice-rich permafrost. They develop along streams or coastlines and expand inland to form landslide-like U-shaped scars (Lantuit et al. 2013).

Subsidence

The volume of ice in permafrost soils, particularly in the first few tens of feet below the ground surface, can be several times the volume of the mineral components (Brewer 1987). Natural and human-induced thawing of this near-surface ice generally results in uneven lowering of the ground surface, which may lead to water ponding or preferential erosion or both (Rawlinson 1993). Because of the presence of ice-rich permafrost, about one-third of the Coastal Plain has the potential for thaw settlement of 16 to 98 feet (Jorgenson et al. 2015).

Flooding and River Ice Jams

Most streams in the Coastal Plain have swift, braided courses across broad gravel flats that typically freeze to the bottom in the winter. In addition, groundwater from seeps and springs that flow throughout the winter freezes and forms thick, layered sheets of ice, called aufeis.[6] During spring when meltwater begins to flow, the presence of ice in the stream channels causes the streams to flood. As meltwater runs over the top of river ice, the ice breaks into pieces. As the ice flows downstream it may lodge in constricted parts of the channel, creating jams and forcing more water out of the stream channel (USACE 2012, p 3-61). Streams draining the Brooks Range also have the potential to produce significant summer precipitation-driven flood discharges (USACE 2012, p. 3-47). Flooding is discussed further in **Section 3.2.10**, Water Resources.

Sea ice Ride-up and Override

On shorelines exposed to the open ocean, onshore winds can push sea ice 100 feet or more onshore and 10 to 20 feet high in a process called sea ice ride-up and override (USACE 2012, p. 3-42). Any natural or human-made features exposed to this sea ice push are susceptible to damage, including shoreline and seabed scouring. Lagoon areas are not generally subject to this phenomenon.

Coastal Erosion and Storm Surge

Beach erosion varies greatly from place to place and year to year along the entire Beaufort coast, depending on storm intensities and the nearness of pack ice. Erosion and deposition of eroded sands and gravel also produce barrier island or spit migration, especially where established vegetation is absent (Brewer 1987). Gibbs and Richmond (2017) have calculated average and maximum shoreline change rates for two regions of the Coastal Plain. Region 1 is the shoreline from the US-Canada border to the Hulahula River, and Region 2 is the shoreline from the Hulahula River to the Staines River. For both Region 1 and 2, the average rate of shoreline change is 3 feet per year over the short term and long term. The negative value indicates that, overall, erosion is greater than accretion. The maximum long-term and short-term rates of erosion observed in Region 1 are 48 and 64 feet per year, respectively. The maximum rates of erosion in Region 2 are both 22 feet per year. In this study, erosion indicates

[6] A mass of layered ice that forms from successive flows of groundwater during freezing temperatures.

landward movement or retreat of the shoreline and does not distinguish between physical erosion and flooding of the coast due to land subsidence or sea level rise.

Erosion along the coast can also be caused by wind. Wind erosion is generally confined to the Canning, Hulahula, Okpilak, and Jago River deltas, where active dunes are found along their western banks, and exposed spits and barrier islands (Clough et al. 1987).

Abnormally high rises in sea level, referred to as storm surges, are caused by strong westerly winds and can be 4 to 6 feet above the elevation of sea level, or even greater with winds at 50 to 60 knots (USACE 2012, p. 3-31). Storm surges can cause coastal flooding, particularly along low profile beaches common in the Coastal Plain.

Additional details regarding shoreline erosion and storm surge along the Beaufort Sea coast can be found in Barnes et al. (1992), USACE (2012, Chapter 3), and Gibbs and Richmond (2015).

Minerals

In the 1970s, before the Alaska National Interests Lands Conservation Act (ANILCA), the USGS and former US Bureau of Mines conducted limited reconnaissance geological and mineral investigations in northeast Alaska. Limited mineral industry work was also conducted in the 1970s (USFWS 2015, p. 4-37). Under ANILCA, the Arctic Refuge was closed to all forms of appropriation under the public land laws, including the mineral leasing and mining laws (USFWS 2015, p. 4-1).

The BLM classifies mineral resources it manages as salable, leasable, or locatable. Salable minerals are subject to the Materials Act of 1947, as amended, and include common construction materials, such as sand, gravel, decorative rock, and building stone. Salable minerals relevant to the Coastal Plain (sand and gravel) are addressed in **Section 3.2.9**, Sand and Gravel Resources.

Leasable minerals generally include energy minerals, such as petroleum, geothermal, and coal resources, as well as potash, sodium, and phosphate. Petroleum resources are addressed in **Section 3.2.7**. Geothermal resources in Alaska are associated with the Aleutian volcanic arc or thermal springs in the interior or southeastern Alaska and have not been identified around the Coastal Plain (Miller 1994).

Coal occurs in isolated areas throughout Alaska, referred to as provinces. The North Slope coal province has the largest coal deposits in Alaska, and the eastern edge of the province extends into the Coastal Plain (Flores et al. 2004; Stricker et al. 2011). The most important Cretaceous coal-bearing rocks in the province are in the Colville and Nanushuk groups west of Prudhoe Bay (Flores et al. 2004). Coal deposits in the eastern North Slope coal province primarily occur in the Tertiary Sagavanirktok Formation in two separate zones and are characterized as sub-bituminous (Stricker et al. 2011).

Locatable minerals are subject to the General Mining Law of 1872 and include metallic minerals, such as gold, silver, copper, lead, zinc, and uranium; nonmetallic minerals, such as alunite, asbestos, barite, gypsum, and mica; and certain varieties of stone. These are also referred to as hardrock minerals. The following discussion addresses locatable minerals and phosphate (a leasable mineral).

The USGS maintains a database with descriptions of mines, prospects, and mineral occurrences in Alaska. The records in the database are generally for metallic mineral commodities only but also may include certain high value industrial minerals, such as barite and rare earth elements. No mineral

occurrences are documented in the Coastal Plain; however, seven mineral occurrences are documented within 15 miles (see **Table 3.2.5-1**, **Map 3-2, Mineral Occurences** in **Appendix A**). These minerals are copper, rare earth elements, phosphorus, uranium, and phosphates.

Table 3.2.5-1
Documented Mineral Occurrences within 15 Miles of the Coastal Plain

Site	Latitude	Longitude	Location Description	Commodities	Ore Minerals	Geologic Description
Unnamed	69.47	-142.82	Accurate to within 5,000 feet	Copper	Chalcopyrite	Mafic volcanic rocks
Aichilik River	69.53	-143.15	Deposit along the Aichilik River; accurate to within 5,000 feet	Rare earth elements	Ytterbium, yttrium	Efflorescent salts coat outcrops of Kingak Shale and accumulate along the margins of ephemeral pools at the foot of cut banks.
Itkilyariak Creek	69.63	-144.75	Accurate to within 4,000 feet	Copper	Native copper	Greenstone, probably Proterozoic
Katakturuk River	69.59	-145.6	1,890 foot-hill at the confluence of two forks of the Katakturuk River, in the headwaters of the Katakturuk River, near the south flank of the Sadlerochit Mountains; accurate to within 1,500 feet	Phosphorus, uranium	Phosphate, uranium	Shublik Formation
Fire Creek	69.53	-145.2	Within 1 mile	Phosphate		Shublik Formation
Hulahula River	69.48	-144.38	Not provided	Phosphate		Shublik Formation
Unnamed	69.63	-144.42	Accurate to within 1 mile	Phosphate		Shublik Formation

Source: USGS 2018b

Hartman (1973) assessed mineral potential in the Arctic Refuge and identified granitic intrusions with metallic mineral deposits in the Romanof Mountains and along the southern edge of the Brooks Range. Closer to the Coastal Plain, Hartman identified abundant low-grade phosphate deposits in the Shublik Formation that crops out along the northern edge of the Brooks Range.

A 1978 report of the mineral resource potential for the Brooks Range included all but the northwest corner of the Coastal Plain (Grybeck and DeYoung 1978). This assessment indicates that most of the Coastal Plain has uranium potential. Just to the south are areas with copper and phosphate potential. The phosphate areas are described as deposits of marine phosphate beds with minor uranium, vanadium, and fluorite content. No information is provided regarding the areas of copper potential.

The Geochemical Atlas of Alaska (Lee et al. 2016) provides maps of the distribution of 68 elements for the state, including the Coastal Plain. The maps are based on compilation and modeling of sediment and

soil samples. These maps indicate, in part, that portions of the Coastal Plain have relatively higher concentrations of gold, uranium, phosphorus, and copper. The maps can be viewed online at https://pubs.er.usgs.gov/publication/ds908.

Direct and Indirect Impacts

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). Consistent with ANILCA, the Coastal Plain would remain closed to all forms of appropriation under the public land laws, including the mineral leasing and mining laws. No impacts on geology or mineral resources would occur.

Impacts Common to All Action Alternatives

As described in the Affected Environment, bedrock is minimally exposed across much of the Coastal Plain. Therefore, existing bedrock outcrops are highly valuable in developing the best possible surface and subsurface geologic understanding of the area. In particular, there are a number of relatively small, low-relief, but critically important bedrock outcrops exposed along the Niguanak and Jago rivers and their tributaries in the northeastern part of the program area (specifically in the area ranging from Townships 6-8 North and Ranges 35-37 East). These exposures are reported to include strata of the Kingak Shale, pebble shale unit, Hue Shale, and Canning Formation (Marshall et al. 1998), whose structural, stratigraphic, and source rock implications remain enigmatic and warrant further geologic study. Important bedrock exposures also occur along the Marsh Creek anticline in the western part of the program area. If gravel infrastructure is placed in these outcrop areas, the bedrock would no longer be accessible for research. Impacts would be long term and last until the gravel is removed.

Land within 1 mile of the Jago River and 0.5 mile of the Tamayariak River would be subject to the no surface occupancy limitations (i.e., only essential pipeline and road crossings permitted) under all action alternatives. This would provide some protection for the outcrops in these areas. No other potential direct or indirect impacts on geology have been identified.

Under ANILCA, the Arctic Refuge, including the program area, was closed to all forms of appropriation under the public land laws, including the mineral leasing and mining laws. With the exception of petroleum and aggregate (sand and gravel) resources, which are addressed in **Section 3.2.6** and **Section 3.2.9**, respectively, the Coastal Plain would remain closed to leasing and mining of mineral resources under all alternatives, including all locatable minerals such as gold, copper, and uranium.

The action alternatives could also affect the risk of several geologic hazards identified in the Affected Environment section, including seismicity, slope failure, subsidence, flooding and river ice jams.

Development of petroleum resources would include injection of seawater or gas into the production field to maintain reservoir pressure. Also, wastewater, produced water, spent fluids, and chemicals would be disposed of in injection wells. Injection of large volumes of fluids into low permeability and brittle rocks has potential to trigger low level seismicity (earthquakes). This phenomenon is generally associated with the high volumes of waste injection associated with the high density of wells needed to fully develop tight unconventional resource plays (shale source rocks, etc.), rather than conventional hydrocarbon production. The potential for induced seismicity associated with the action alternatives would be low.

Slope failure could be triggered or exacerbated by placement of gravel fill. Most of the program area is relatively flat and gravel infrastructure would not likely be placed on slopes with potential for ground movement. At waterbody crossings, roads would be constructed using methods that would minimize potential slope failure along stream banks. Therefore, the potential for leasing and development activities to influence slope failure risk would be low. Likewise, slope failure is unlikely to impact infrastructure associated with the action alternatives.

To minimize the potential for subsidence associated with thawing of near surface ice, gravel pads and roads would be constructed with a thickness sufficient to maintain a stable thermal regime (see **Chapter 2**). All buildings would be supported above ground on pilings to accommodate ground settling or frost heaving.

Under all action alternatives, the risk of flooding and river ice jams would be mitigated by a required operating procedure which states, "the design engineer should ensure that crossing structures are designed for aufeis, permafrost, sheet flow, additional freeboard during breakup, and other unique conditions of the arctic environment."

Alternative B

Impacts on geology and mineral resources under Alternative B would be the same as identified above for all action alternatives.

Alternative C

Impacts on geology and mineral resources under Alternative C would be the same as identified above for all action alternatives.

Alternative D

In addition to the impacts described above for all action alternatives, no surface occupancy would be allowed within 0.5 mile along the Niguanak River, Katakturuk River, and Marsh Creek under Alternative D. While this restriction could help mitigate the potential for outcrops in these areas to be covered by gravel fill, some of the key outcrops (those in the northern part of Township 6 North, Range 36 East) are along intermittent tributaries up to 5 miles west of the Niguanak River.

Cumulative Impacts

The geographic area relevant for assessing cumulative impacts for geology and minerals is the program area. No other past, present, and reasonably foreseeable future actions that could impact geology or mineral resources have occurred or would occur in the program area.

Climate would not affect geology or mineral resources within the timeframe of development but could have an impact on several geologic hazards, including subsidence, flooding, and coastal erosion. Coastal erosion effects are addressed in the Cumulative Impacts discussion in **Section 3.2.4,** Physiography. An increase in the active layer expected from a warming climate could result in greater areas of land subsidence. Climate variability is also expected to affect the frequency and severity of extreme storm and flood events. Storms with storm surges will be stronger and more frequent, which, combined with rising sea levels. could lead to greater coastal erosion (BLM 2012). The spring warming period will begin earlier causing snowmelt to occur during a period of lower solar radiation, which could lead to a more protracted melt and less intense runoff. Overall, the magnitude and frequency of high flows will decline

while low flows will increase. These effects are described in more detail in the Draft Supplemental Environmental Impact Statement for the Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project (BLM 2018, Section 3.2.4).

3.2.6 Petroleum Resources

Affected Environment

Regulatory Information

Section 20001 of Public Law 115-97 authorizes the Department of the Interior (DOI) to undertake an oil and gas leasing program on the Coastal Plain (previously known as the 1002 Area) of the Arctic National Wildlife Refuge. Under the ANILCA, the Coastal Plain was not designated wilderness, and Congress reserved the area for potential future oil and gas development. The Tax Cuts and Jobs Act of 2017 opened the entire Coastal Plain, with the exception of Alaska Native selected lands within the Coastal Plain boundary, to leasing; however, it limited surface disturbance from oil and gas production to a 2,000-acre maximum.

Oil and Gas Resources

The Coastal Plain encompasses approximately 1,590,900 acres. Currently no acreage is open to petroleum leasing. It is estimated that approximately 427,900 acres of the program area is high potential for petroleum resources, 686,700 acres are moderate potential, and 476,300 acres are low potential. Estimates are based on best available information, but due to the limited amount of exploration that has occurred in the area, petroleum development potential and acreages should be considered rough estimates. Most test wells drilled in the Coastal Plain are held as confidential information, so exact formation compositions and oil and gas percentages are not well established across the entire region. Existing oil and gas wells are shown in **Map 3-3, Existing Oil and Gas Wells** in **Appendix A** See the RFD Scenario (**Appendix E**) for more information on development potential, assumptions behind potential estimates, and estimates for the baseline future development scenario for petroleum.

Approximately 80 percent of petroleum resources are estimated to be in the undeformed western portion of the program area (USGS 1998). As shown in **Table 3.2.6-1**, the identified potential plays in the undeformed area are the Topset play, Thompson play, Turbidite play, Wedge, Kemik, and Undeformed Franklinian. Potential plays in the deformed area are the Thin-Skinned Thrust Belt, Ellesmerian Thrust Belt, Deformed Franklinian, and Niguanak/Aurora (Attanasi 2005).

The Topset is expected to be the primary play in the Coastal Plain, with an estimated technically recoverable 4.325 billion barrels of oil (BBO) and 1.193 trillion cubic feet (TCF) of gas. The Turbidite play is the second most productive, with an estimated technically recoverable 1.279 BBO and 1.120 TCF of gas. In the deformed area, the Thin-Skinned Thrust Belt is the primary play, with an estimated technically recoverable 1.038 BBO and 1.608 TCF of gas (Attanasi 2005). In total, the undeformed area is estimated to contain a technically recoverable total of 6.420 BBO and 3.424 TCF of gas, and the deformed area is estimated to contain a technically recoverable total of 1.267 BBO and 3.617 TCF of gas. Natural gas liquids will also be produced as part of the oil and gas production process.

Table 3.2.6-1
Estimated Mean Undiscovered Petroleum Resources in the Coastal Plain

Play Name	Oil (BBO)	Gas (TCF)	Natural Gas Liquids (Billion Barrels of Liquid)
Undeformed			
Topset	4.325	1.193	0.010
Turbidite	1.279	1.120	0.065
Wedge	0.438	0.226	0.005
Thompson	0.246	0.470	0.039
Kemik	0.047	0.116	0.010
Undeformed Franklinian	0.085	0.30	0.029
Undeformed subtotal	*6.420*	*3.424*	*0.159*
Deformed			
Thin-Skinned Thrust Belt	1.038	1.608	0.017
Ellesmerian Thrust Belt	0.000	0.876	0.018
Deformed Franklinian	0.046	0.86	0.046
Niguanak/Aurora	0.183	0.273	0.016
Deformed subtotal	*1.267*	*3.617*	*0.096*
Total	7.687	7.041	0.225

Source: Attanasi 2005
Note: Totals are technically recoverable amounts; oil associated gas and natural gas liquid estimates were combined with non-oil associated gas and natural gas liquid estimates.

Trends

Due to a prohibition on leasing, there has been no development of oil and gas resources in the Coastal Plain to date. There has been interest in Alaska and from some Native corporations in developing the Coastal Plain ever since the "1002 Area" was designated as a potential area for development in 1980 (Doyon Limited 2018; Rexford 2017). The area has had limited exploration; as further exploration occurs, a greater understanding of the size and characteristics of petroleum resources will be gained.

Eighty to 90 percent of technically recoverable reserves were estimated to be economically recoverable at $42/barrel. The threshold price to initiate exploration was estimated to be from $20 to $21/barrel. The current price of West Coast crude is around $75/barrel. The current price of West Texas Intermediate crude is around $65/barrel. The US Energy Information Agency forecasts the price of crude oil to steadily rise to over $85/barrel over the next 10 years (U.S. Energy Information Agency 2018).

Direct and Indirect Impacts

This section discusses the direct and indirect impacts to petroleum resources of the alternatives being considered. The scope covers the potential impacts from leasing and subsequent production of petroleum resources.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales following the Record of Decision for this EIS. Alternative A would not include the direction under the Tax Cuts and Jobs Act of 2017 to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain within the Arctic Refuge. Under this alternative, current management actions

would be maintained and resource trends would continue, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). No extraction or use of petroleum resources would occur and as a result no impacts to petroleum resources would occur.

Impacts Common to All Action Alternatives

Impacts to petroleum resources under all action alternatives can reasonably be expected to result in the irreversible commitment of petroleum hydrocarbon resources of the Public Law 115-97 through oil and gas leasing. However, the stated purpose of this EIS is to facilitate petroleum leasing, development and production.

Impacts to petroleum resources would vary based on the amount of acreage available for leasing and restrictions on access to available acreage. Under all action alternatives, surface disturbance is expected to reach the 2,000-acre maximum for surface disturbance.

It is estimated that the program area contains approximately 7.687 billion barrels of technically recoverable oil and 7.041 trillion cubic feet of technically recoverable natural gas. Due to high costs associated with operating in the arctic it is extremely unlikely that all technically recoverable resources will be produced. The US Energy Information Administration estimated that a total of approximately 3.4 billion barrels of oil (BBO) would be produced in the Arctic Refuge from 2031 to 2050 (EIA 2018). Oil would be transported to market by a connection to the TAPS.

Given the uncertainty involved in producing from currently undiscovered pools within a poorly studied area, the variances in production by alternative cannot be predicted. No surface occupancy (NSO) restrictions could require that well pads be located outside of optimal locations for the most efficient oil recovery under some alternatives; however, horizontal drilling technology would allow operators to recover gas from these areas. Under some alternatives, additional pads could be required to access all areas, and per pad production would be reduced but over production would not change significantly.

No gas production is anticipated within the timeframe of this EIS due to low natural gas prices and a lack of infrastructure to transport gas to market (**Appendix M**, RFD Scenario). Any co-occurring or incidental gas produced with oil would be re-injected to maintain reservoir pressure or flared to the atmosphere.

Wells would be fractured to stimulate initial production but no hydraulic fracturing to produce unconventional resources is anticipated (**Appendix M**, RFD Scenario). There currently is no unconventional oil and gas production on Alaska's North Slope (BLM 2012), due to the high costs of and difficult operating conditions in the arctic the viability of hydraulic fracturing of unconventional petroleum resources has not been proven from a technology or commercial viability standpoint.

Under all action alternatives spills and leakage of petroleum resources are expected to result in a loss of productive use of those resources. The National Petroleum Reserve Alaska (NPR-A) large (500 barrels or greater) historic crude oil spill rate is 0.65 spills per BBO produced with an average spill size of 1,229 barrels. During that time the North Slope produced at total of 12.40 BBO. The historic small (less than 500 barrels) crude oil spill rate from 1989 to 2009 for the Alaska North Slope is 187 spills per billion barrels produced with an average spill size of 2.8 barrels (117.6 gallons). During this time 9.4 BBO were produced (BLM 2012).

With an estimated 3.4 BBO of production anticipated from the Coastal Plain, and assuming the same spill rates as NPR-A, it is reasonable to anticipate a program area spill total of approximately 1,780 barrels of oil spilled in approximately 636 small spills, and a total of approximately 2,716 barrels spilled in two or three large spills. In addition to damage to the environment, spills represent a loss of petroleum resources from productive use. Using a high case scenario using a USGS estimate that 9.3 BBO would be economically recoverable (Attanasi and Freeman 2009), it could be expected that there would be approximately 1,739 small spills with a total of approximately 4,869 barrels spilled, and approximately 6 large spills with a total spill size of 7,374 barrels.

Alternative B

Table 3.2.6-2 shows acreages which would be subject to no surface occupancy (NSO) restrictions, controlled surface use (CSU) restrictions, timing limitations (TL), or would be open to leasing under standard terms and conditions. A total of 1,562,700 acres would be available for leasing under this alternative.

Table 3.2.6-2
Leasing Stipulation Acreages for Alternative B

	Low oil potential (acres)	Medium oil potential (acres)	High oil potential (acres)	Total (acres)
NSO	88,200	72,700	103,100	264,000
Standard terms	4,300	181,400	268,900	454,600
Timing Limitations	384,500	403,700	55,800	844,100
Total	**476,900**	**657,900**	**427,900**	**1,562,700**

Source: BLM GIS 2018

This alternative opens the greatest acreage to petroleum extraction. Fewer restrictions on the locations of CPFs and drill pads exist under this alternative.

Alternative C

Table 3.2.6-3 shows acreages which would be subject to NSO, CSU, or TL restrictions, would not be offered for leasing, or would be open to leasing under standard terms and conditions. A total of 1,086,100 acres would be available for leasing under this alternative.

Table 3.2.6-3
Leasing Stipulation Acreages for Alternative C

	Low oil potential (acres)	Medium oil potential (acres)	High oil potential (acres)	Total (acres)
Not offered for lease	366,100	110,500	0	476,600
NSO	41,000	183,600	165,100	389,700
Standard terms	100	137,600	208,200	345,900
TL	69,800	226,200	54,500	350,500
Total	**476,900**	**657,900**	**427,900**	**1,562,700**

Source: BLM GIS 2018

This alternative would close 476,600 acres of the program area to leasing. This closure represents approximately 30 percent of the program area; however, the area closed to leasing is located in low and moderate petroleum potential sections of the project area projected to have small accumulations of petroleum, so the percentage of petroleum resources closed to leasing would be less than 30 percent of the economically recoverable petroleum resources. See **Map 3-5, Hydrocarbon Potential, Alternative C** in **Appendix A** for more detail. Under this alternative the acreage subject to NSO stipulations would still allow for CPF and drill pad siting to maximize recovery from each pad.

Alternative D1

Table 3.2.6-4 shows acreages which would be subject to NSO, CSU, or TL restrictions, would not be offered for leasing, or would be open to leasing under standard terms and conditions under Alternative D1. A total of 1,036,400 acres would be available for leasing under this alternative.

Table 3.2.6-4
Leasing Stipulation Acreages for Alternative D1

	Low oil potential	Medium oil potential	High oil potential	Total
CSU acres	11,000	80,500	32,400	123,900
Not offered acres	398,300	120,700	7,300	526,300
NSO acres	67,700	384,000	256,200	707,800
Standard terms acres	0	72,800	131,900	204,700
Total	**476,900**	**657,900**	**427,900**	**1,562,700**

Source: BLM GIS 2018

The 526,300 acres which are closed to leasing represent approximately 33 percent of the project area. The area closed to leasing is located in low and moderate petroleum potential sections of the project area projected to have small accumulations of petroleum, so the percentage of petroleum resources closed to leasing would be less than 33 percent of the economically recoverable petroleum resources. See **Map 3-6, Hydrocarbon Potential, Alternative D1** in **Appendix A**.

Approximately 45 percent of the project area is subject to NSO stipulations which would limit the location of CPFs and drill pads, potentially resulting in changes to pad configurations. NSO stipulations exist in portions of the high, medium and low areas.

Alternative D2

Table 3.2.6-5 shows acreages which would be subject to NSO, CSU, or TL restrictions, would not be offered for leasing, or would be open to leasing under standard terms and conditions under Alternative D2. A total of 1,036,400 acres would be available for leasing under this alternative.

The 526,300 acres which are closed to leasing represent approximately 33 percent of the project area. The area closed to leasing is located in low and moderate petroleum potential sections of the project area projected to have small accumulations of petroleum, so the percentage of petroleum resources closed to leasing would be less than 33 percent of the economically recoverable petroleum resources. See **Map 3-7, Hydrocarbon Potential, Alternative D2** in **Appendix A**.

Table 3.2.6-5
Leasing Stipulation Acreages for Alternative D2

	Low oil potential	Medium oil potential	High oil potential	Total
CSU acres	11,000	80,500	32,400	123,900
Not offered acres	398,300	120,700	7,300	526,300
NSO acres	67,700	384,000	256,200	707,800
TL acres	0	72,800	131,900	204,700
Total	**476,900**	**657,900**	**427,900**	**1,562,700**

Source: BLM GIS 2018

Approximately 45 percent of the project area is subject to NSO stipulations which would limit the location of CPFs and drill pads, potentially resulting in changes to pad configurations.

Cumulative Impacts

Oil and gas leasing program and subsequent exploration, development, and production activities around the North Slope has and will continue to result in irreversible commitment of oil resources. The Alaska Liquid Natural Gas Project and the Alaska Stand Alone Gas Pipeline, if completed, could potentially result in the irreversible commitment of gas resources. Scientific research could result in a better understanding of the type and size of petroleum resources in the project area. Spills of produced petroleum products from the project would result in an irreversible loss of those resources. Drilling near the boundaries of the program area has the potential to drain petroleum resources from pools that extend outside of the program area, this would represent a loss of petroleum resources from any future developments in those areas outside the boundary.

The production and subsequent consumption of petroleum resources would contribute to climate change. The EPA estimates that 0.43 metric tons of carbon dioxide (CO^{2}) is produced per barrel of oil consumed (EPA 2018). Assuming the EIA projection of 3.4 BBO produced approximately 1.46 billion metric tons of CO2 would be produced. In a high case scenario using a US Geological Survey estimate, 90 percent of 10.35 BBO would be economically recoverable (Attanasi and Freeman 2009) we could assume that a production of 9.32 BBO would result in approximately 4.01 billion metric tons of CO^{2}.

3.2.7 Paleontological Resources

Affected Environment

Paleontological resources include any physical evidence of past life, including fossilized flora and fauna, imprints, and traces of plants and animals. The program area, and all of the North Slope, is widely regarded as fossiliferous.[7] It has borne evidence of past habitation that has expanded the scientific community's understanding of the geologic and paleontological record worldwide (BLM 2012).

As discussed in **Section 3.2.5,** Geology and Minerals, various geologic units have been identified in the program area. This includes ten bedrock geologic units, with unconsolidated surficial deposits, covering more than 80 percent of the surface area. Eight of these ten units have potential or documented fossils, though the presence of paleontological features has not been specifically noted in outcrops in the

[7] Rich in fossils or fossil potential

program area. Program area bedrock geologic units and their approximate acreage in the program area are shown on **Map 3-8, Paleontological Resources** in **Appendix A** and are noted below.

The Potential Fossil Yield Classification (PFYC) system is a tool used to assess potential occurrences of paleontological resources in mapped geologic units. It provides classifications that may be used to assist in determining the need for further assessment or actions. The PFYC system is created from available geologic maps and assigns a class value to each geological unit, representing the potential abundance and significance of paleontological resources that occur in that geological unit. PFYC values range from Class 1, Very Low, to Class 5, Very High, which indicate both the probability for the mapped unit to contain significant paleontological resources as well as the degree of management concern for the resource. Geologic units without enough information associated with them to assign a PFYC value may be assigned Class U, Unknown Potential. Characteristics of PFYC values are included in **Appendix F,** Paleontological Resources.

The PFYC model for Alaska is in development. Preliminary PFYC values have been assigned to the mapped geologic units in the program area and are included in **Table 3.2.7-1**. Excerpts from the in-progress PFYC model regarding preliminary rankings and unit descriptions are included in **Appendix F,** Paleontological Resources. These PFYC assignments are maintained and updated by the BLM as additional data is available. The PFYC model in development relies on the geologic mapping presented in Wilson, et al. 2015; some of the mapped units are characterized differently than those presented in **Section 3.2.5**, Geology and Minerals.

Table 3.2.7-1
PFYC Values of Program Area Geologic Bedrock Units

Geologic unit	Acres in Program Area (Approximate)	Age (millions of years ago [mya])	PFYC value	Noted fossil presence in unit
Prince Creek Formation	25,300	Upper Cretaceous, (100.5 – 66 mya)	5	Includes dinosaur-bone-bearing beds on the Colville River
Sagavanirktok Formation	16,900	Tertiary (65 – 2.8 mya)	3-4	Floral, microfauna, and mollusk fossils
Canning Formation	8,500	Cretaceous to Tertiary (145 – 2.8 mya)	U	None noted
Sadlerochit Formation	2,800	Lower Triassic to Permian (289.9 – 247.2 mya)	3	Ammonites, pelecypods, and brachiopods
Seabee Formation and Hue Shale	1,300	Cretaceous (145 – 66 mya)	3-4	Ammonites, pelecypods, fish remains, bird trace fossil (footprint)
Lisburne Group, undivided	500	Carboniferous (358.9 – 298.9 mya)	3	Group noted as generally fossiliferous. Contains corals, brachiopods, ammonites, nautiloids, and plants.
Kemik Sandstone	200	Lower Cretaceous (146 – 100 mya)	2-3	Trace fossils (footprints)
Kongakut Formation	200	Lower Cretaceous	2-3	Pelecypods and

Table 3.2.7-1
PFYC Values of Program Area Geologic Bedrock Units

Geologic unit	Acres in Program Area (Approximate)	Age (millions of years ago [mya])	PFYC value	Noted fossil presence in unit
Kingak Shale	200	(146 – 100 mya) Jurassic (201.3 – 145 mya)	3	abundant worm borings Marine mollusks and crinoids; pelecypods and ammonites
Nanushuk Formation	100	Upper Cretaceous, (100.5 – 66 mya)	5	Bivalve, insect, marine megafauna, plant, and dinosaur fossils

Pleistocene, or ice age, fossils from between 2.59 million and 11,700 years ago have been identified across the North Slope in surficial quaternary deposits. These are the same deposits that cover approximately 1.4 million acres of the program area. Most of the recorded fossils exposed in North Slope surficial deposits are a result of stream bank erosion. These fossils include remains of animals that existed at the same time as human habitation of the area: horses, mammoths, antelope, bison, bears, lions, muskoxen, caribou, and moose (BLM 2018).

Most paleontological resources identified on the North Slope have been identified in areas west of the program area. A description of the history of fossil discovery on the North Slope and conclusions regarding the fossil record is in BLM 2012, Section 3.2.7, and BLM 2018, Section 3.2.1.6.

Direct and Indirect Impacts

Alternative A

Under Alternative A, current management actions would continue as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). Changes to paleontological resources, such as increased exposure due to changes in permafrost, river bank erosion, coastal erosion, and weathering, would continue to occur along current trends. There would be no direct or indirect impacts to paleontological resources from Alternative A.

Impacts Common to All Action Alternatives

The limited bedrock outcrops are the only source for understanding the distribution and type of paleontological resources in the program area. As described **Section 3.2.5**, Geology and Minerals, if project-related infrastructure is located in these outcrop areas, gravel fill over bedrock would restrict the ability to evaluate and observe paleontological resources; however, placement of gravel fill would also protect the outcrop from erosion, which may support preservation of the resource. Impacts would be long term and last until the gravel is removed. Direct impacts to paleontological resources would be limited to ground-disturbing activities, including drilling and gravel mining. Land within 1 mile of the Jago River, which is in the area of the Prince Creek Formation, would be subject to the NSO limitations (i.e., only essential pipeline and road crossings permitted) under all action alternatives. Based on these restrictions, the likelihood of impacts on paleontological resources under any of the action alternatives is low.

Indirect impacts to paleontological resources are due to increased exposure, either to humans or the elements. Since the resources within the program area have not been extensively studied, increased exposure from infrastructure construction and operation near bedrock outcrops may support additional scientific research and identification of paleontological resources. Similarly, improving access to areas with paleontological resources may increase unauthorized fossil removal, looting, and damage. Removal of ground cover that would expose fossil-bearing units would expose the unit to weathering influences, which may disturb the resource and its context.

Alternative B

Impacts on paleontological resources under Alternative B would be the same as identified above for all action alternatives.

Alternative C

Impacts on paleontological resources under Alternative C would be the same as identified above for all action alternatives.

Alternative D

Impacts on paleontological resources under Alternative D would be the same as identified above for all action alternatives.

Cumulative Impacts

BLM (2018) notes that activities with the potential to adversely affect paleontological resources are required to have professional inventories filed with BLM prior to beginning specific proposed actions. These requirements include stipulations to minimize or eliminate adverse impacts to paleontological resources. No other past, present, and reasonably foreseeable future actions that could impact paleontological resources have occurred or would occur in the program area. Therefore, no cumulative impacts to paleontological resources would occur.

Changing climate conditions would not affect paleontological resources but may have an impact on several geologic hazards, including thawing permafrost and coastal erosion. An increase in the active layer expected from a warming climate could result in greater areas of land subsidence, which may expose geologic units with paleontological resources to weathering action. Similarly, coastal erosion will expose previously-protected units to weathering, which may expose and damage resources. Given the surficial context of these actions, the geologic unit with the greatest risk is the unconsolidated and poorly consolidated surficial Quaternary deposits, which may contain Pleistocene fossils.

3.2.8 Soil Resources

Affected Environment

The Coastal Plain is in the Coastal Plain physiographic sub-province and portions of the Arctic Foothills physiographic sub-province. The soils in the Coastal Plain sub-province are composed of poorly drained, unconsolidated sediments transected by fluvial deposits of rivers and stream flowing northward from the rolling foothills to the south (Wahrhaftig 1965). Most uplands in the program area are in the western half and extend from the foothills of the Sadlerochit Mountains southern boundary to near the coastline. Lowland Coastal Plain deposits east of the Hulahula River are interbedded marine and alluvial deposits associated with past marine transgressions. These soils generally include fluvial sands and gravels, silty

sand, and organic silt over marine silts and clays. These soils are generally ice rich and contain ice wedges (Jorgenson 2018).

Eolian deposits comprise nearly 30 percent of the surficial soil deposits in the program area and can range from 3 to 100 feet thick (Jorgenson 2018; Rawlinson 1993). Eolian deposits in flat lowland areas are normally frozen, with a high ice content; hillslopes generally have a thin eolian deposit cover and are usually unfrozen on south-facing slopes. Alluvial and fluvial deposits, including active braided channels, terraces, and deltaic deposits, consist of sands and gravels in steeper gradients near the foothills. They transition to finer grained soils in floodplains and inactive channels (Jorgenson 2018).

The Sadlerochit Mountains bordering the southwestern edge of the program area are composed of Tertiary sandstone and conglomerate noncarbonate sedimentary rocks. Colluvium deposits drape the northern slopes of the Sadlerochit Mountains and are composed of loose, silty to rubbly, unsorted deposits derived directly from weathering bedrock deposits upslope. Colluvium deposits are usually vegetated (Jorgenson 2018). At the southern border of the program area, the Canning River and Hulahula River drainages are capped by glacial moraine deposits, consisting of silty sands and gravels, with some cobbles and boulders (Rawlinson 1993).

The entire program area is underlain by permafrost at least 1,000 feet thick with isolated areas of thaw near deep lakes, springs, and rivers (Bird and Magoon 1987). Depending on their depth and size, lakes and rivers influence the presence of permafrost; deeper lakes and rivers, such as the Canning River, often form a thaw bulb below the water body (Rawlinson 1993). Permafrost and ground ice characteristics are variable, due to differences in climate, topography, soil properties, cryogenic processes, and environmental history (Jorgenson 2018). Massive ice occurs in the form of ice wedges, buried glacial ice in glacial deposits, and intrusive ice (Jorgenson 2018). Permafrost in the Coastal Plain is generally between 650 and 1,300 feet thick (USFWS 2015). Polygonal patterned ground is created when ice wedges form in the upper few feet of the ground surface and, which is indicative of ice-rich soils. Polygonal ground is a common surface feature in the program area, especially in lowland areas; polygons may be less apparent in drained upland areas, where vegetation can mask these surface features (Rawlinson 1993).

The top layer of the soil surface that typically thaws and refreezes annually is known as the active layer. In the Coastal Plain, the active layer is generally between 1 and 4 feet thick (USFWS 2015). Active layer thickness can vary from year to year and depends on such factors as ambient air temperature, aspect, gradient, vegetation, drainage, snow cover, water content, and soil type. Long-term permafrost temperature monitoring shows a warming trend over the past 25 years, with the greatest warming near the coast. Soil temperatures increased 3 to 5 degrees Fahrenheit between 1985 and 2004 (USFWS 2015).

At the approximately 4-foot depth at three USGS monitoring stations in the program area, average subsurface temperatures showed warming trends between 2000 and 2015 (Urban and Clow 2017) Degradation of permafrost can be affected by ice content, soil or vegetation removal, and ground disturbances, with ice-rich and thaw-unstable soils and hillsides being the most sensitive to thawing (ADNR 2018). Thawing, ice-rich, permafrost soils create thermokarst features that transform the landscape by subsidence, erosion, and changes in drainages, including channelization and ponding (USFWS 2015). Changes in the landforms due to erosion and thermokarst, such as slumping and channelization, affects the vegetation and water characteristics of the area (USFWS 2015).

Direct and Indirect Impacts

Direct and indirect impacts resulting from the develop and operation of facilities identified in the RFD scenario (**Appendix E**) include:

- The placement of gravel fills for pads, roads, and airstrips
- Construction of vertical support members for pipelines and building foundations
- Construction of ice roads and pads
- Removal of sand and gravel resources for embankment fills

These actions cause changes and disturbance of the insulating surface vegetation layer and result in thawing of the permafrost and development of thermokarst structures. Thermokarst changes the surface topography, increasing water accumulation, changing surface water drainage patterns, and increase the potential for soil erosion and sedimentation (BLM 2018).

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). The Coastal Plain would remain undeveloped. No direct or indirect impacts on soils or permafrost would occur.

Impacts Common to All Action Alternatives

Under all action alternatives, approximately 2,000 acres of disturbance due to placement gravel fills and vertical support members for construction of roads, pads, airstrips, and structures would occur and result in direct impacts on soil quality and permafrost within and adjacent to the gravel fill footprint. Changes to surface drainage due to the placement of fills causes permafrost thawing, subsidence, and the accumulation of water, which would not occur under Alternative A. Placement of fills would cover soils and kill existing vegetation, altering the thermal active layer (USACE 2018). Installation of vertical support members for pipelines will displace and disturb soils around the vertical support member (BLM 2018).

By changing drainage patterns of surface water, ponds and channels form and concentrate water that accelerates permafrost thaw. Where drainage patterns are altered, blockages can lead to ponding and sediment deposition. Where drainage patterns redirect surface flow or increase velocities, such as at embankments, erosion of sediments occurs (BLM 2018).

Indirect impacts on soil and permafrost within and adjacent to the gravel fill footprints would be due to dust deposition and snow accumulation. Fugitive dust would be suspended in the air by vehicle and equipment use and would settle onto surrounding vegetation and snow, which would decrease surface albedo. This can increase thermal conductivity, leading to permafrost thaw (USACE 2018). Dust accumulation can also impact the pH of the surrounding soils, which lead to changes in the health and growth of vegetation that hold soil in place. These impacts would not occur under Alternative A.

Blowing snow conditions due to changes in topography from the construction of pads and roads and vertical support members/infrastructure foundations changes the thermal regime of the soils and permafrost adjacent to the pad and road or vertical support members. Snow accumulation insulates the underlying soil during the winter months, increasing the overall soil temperatures and leading to

permafrost thaw at those locations. Snow accumulation would occur more frequently on the leeward side of embankments (USACE 2018).

Sand and gravel material extraction would be required to provide materials for embankment construction and will have impacts on the permafrost and soils within the mine site footprint and around its perimeter. **Section 3.2.9**, Sand and Gravel Resources discusses the impacts of material extraction in further detail.

Reclamation of roads and pads would be subject to the permitting process. Removal of gravel would affect the underlying soil and permafrost resources by exposing the underlying soils to increased radiation and leading to continued permafrost degradation (USACE 2018). None of these impacts would occur under Alternative A.

Alternative B

Impacts on soils and permafrost under Alternative B would be the same as identified above for all action alternatives. Approximately 12,509,000 cubic yards of material is required for construction of the embankment infrastructure, estimated to be up to 310 acres of disturbance to the ground surface and soils at material extraction sites. These actions would not occur under Alternative A.

Alternative C

Impacts on soils and permafrost under Alternative C would be the same as identified above for all action alternatives. Approximately 12,722,000 cubic yards of material is required for construction of the embankment infrastructure, estimated to be up to 315 acres of disturbance to the ground surface and soils at material extraction sites. These actions would not occur under Alternative A.

Alternative D

Impacts on soils and permafrost under Alternative D would be the same as identified above for all action alternatives. Impacts are common to all alternatives. Approximately 12,420,000 cubic yards of material is required for construction of the embankment infrastructure, estimated to be up to 308 acres of disturbance to the ground surface and soils at material extraction sites. These actions would not occur under Alternative A.

Cumulative Impacts

The geographic area relevant for assessing cumulative impacts for soils and permafrost is the program area. Previous seismic survey explorations and an exploratory test well in the program area have resulted in disturbance to the surface vegetation and impacted the thaw of permafrost, changes in drainage patterns, and changes in vegetation growth (USFWS 2018). The potential climate change impacts in the program area remain essentially as described in BLM (2018). Each of the proposed RFD scenarios have the potential to impact over 2,000 acres of soils and permafrost (**Appendix E**). The impacts are related to changes to topography and landforms resulting in changes to soil chemical composition, drainage patterns, and erosion of soils. Disturbance to surface vegetation directly leads to changes in the thermal regime of soils due to placement of gravel fills for pads and roads.

3.2.9 Sand and Gravel Resources

Affected Environment

Sand and gravel resources are most commonly present in the Coastal Plain in the valleys of larger rivers and streams (Bird and Magoon 1987); the valleys of larger streams are underlain by coarse sand and gravel. These include the Canning, Sadlerochit, Hulahula, and Aichilik Rivers, which are heavily braided and have extensive gravel bars generally free of vegetation. Sediments on the Coastal Plain in the western half of the program area are dominated by outwash sediments covered by younger fluvial sands and gravels; the outwash sediments are either directly below the fluvium or have been eroded and replaced by the fluvium (Rawlinson 1993).

The Canning River valley on the western border of the program area was formed by a large valley glacier. It formed a piedmont lobe along the Canning River and Tamayariak Rivers, depositing glaciofluvial soils (Bird and Magoon 1987). These soils are composed of outwash sediments deposited in multiple terraces, formed by glacial outwash washed downstream, and are capped by younger alluvial deposits. The outwash deposits near the northern boundaries of the program area are covered by eolian sand and overlain by lacustrine silt and peat, exposed at stream cuts and bank exposures (Rawlinson 1993).

Sediments in the program area are dominated by outwash sediments covered by younger fluvial sands and gravels. The outwash sediments are either directly below the fluvium or have been eroded and replaced by it (Rawlinson 1993). Sands and gravels are often found in elevated terrain between river valleys and alluvial fans originating from the foothills to the south (Rawlinson 1993). Soils downstream and closer to the coastline become progressively fine grained, transitioning to deltaic and marine deposits (Bird and Magoon 1987).

Existing material sources in the Coastal Plain and west and outside of the program area are in similar geological environments and next to streams. These sites are reportedly excavated to depths of approximately 45 feet below the surface and are in similar glaciofluvial and fluvial deposits. These deposits have been observed to contain ice wedges and thin discontinuous beds of fine-grained material with abundant detrital wood debris (Rawlinson 1993).

Direct and Indirect Impacts

Direct and indirect impacts resulting from the develop and operation of facilities identified in the RFD scenario (**Appendix E**) include the removal of sand and gravel resources for embankment fills. These actions cause changes and disturbance of the surface vegetation layer and excavation of landforms, resulting in changes to surface drainage, erosion of soils, and thawing of permafrost.

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). The Coastal Plain would remain undeveloped. No direct or indirect impacts on sand and gravel resources would occur.

Impacts Common to All Action Alternatives

Sand and gravel resources would be required for leasing programs under each of the action alternatives. Extraction of sand and gravel resources would be needed for the construction of roads and pads. Sand and gravel would likely be obtained from more than one newly-permitted mine site near the

development and would be accessed during winter months via ice roads. Sand and gravel mining would alter the geomorphic landforms and remove vegetation, leading to permafrost thaw. Upon closure, and depending upon reclamation requirements, the mine sites would likely be inundated with surface water, forming a lake. By changing the drainage patterns of surface water, ponds and channels form and concentrate water that accelerates permafrost thaw. Where drainage patterns are altered, blockages can lead to ponding and sediment deposition. Where drainage patterns redirect surface flow or increase velocities, such as at embankments, erosion of sediments occurs. Water impoundment in a flooded pit would likely remain unfrozen near the bottom, creating a thaw bulb around and beneath the pit, which may cause the excavation walls to slough and deposit material into the pit (BLM 2018).

Removal of gravel from areas near or within streams could result in changes to stream configurations, hydraulics, flow patterns, erosion, sedimentation, and ice damming. Material extraction produces sedimentation (USACE 2018). These actions would not occur under Alternative A.

Alternative B

Approximately 12,509,000 cubic yards of material would need to be mined for gravel pads and roads. The area footprint of a 25-foot deep pit is 310 acres. Multiple material source sites are expected to be used to meet the material demands and reduce haul distances. Based on areas of high potential mineral leasing under this alternative (**Map 3-4, Hydrocarbon Potential Alternative B** in **Appendix A**), material sources are anticipated to be primarily within the outwash sediments from the Sadlerochit Mountains in the southwestern portion of the program area and within alluvial deposits of larger rivers. These actions would not occur under Alternative A.

Alternative C

Approximately 12,722,000 cubic yards of material would need to be mined for gravel pads and roads. The area footprint of a 25-foot deep pit is 315 acres. Multiple material source sites are expected to be used to meet the material demands and reduce haul distances. Based on areas of high potential mineral leasing under this alternative, material sources are anticipated to be primarily within the outwash sediments from the Sadlerochit Mountains in the southwestern portion of the program area and within alluvial deposits of larger rivers. These actions would not occur under Alternative A.

Alternative D

Approximately 12,420,000 cubic yards of material would need to be mined for gravel pads and roads. The area footprint of a 25-foot deep pit is 308 acres. Multiple material sources sites are expected to be used to meet material demands and limit haul distances. Based on areas of high potential mineral leasing under this alternative, material sources are anticipated to be primarily from fluvial deposits between the Canning and Tamayariak Rivers and material resources may be limited to streams and topographic high points. These actions would not occur under Alternative A.

Cumulative Impacts

The geographic area relevant for assessing cumulative impacts for soils and permafrost is the program area. Permanent changes to landforms and vegetation due to material extraction will lead to changes in permafrost. Changes to permafrost likely due to thaw and will result in subsidence, formation of thaw bulbs, and changes to drainages within and around the perimeter of the material site.

Potential climate change impacts in program area would not affect the existence or location of the sand and gravel deposits within the program area; however, changes in climate may impact access to those resources. Sand and gravel resources in the program area will use ice roads for access to the material sites. Depending on the excavation methods to mine sand and gravel resources, climate change could make the excavation easier due to thawing permafrost or more difficult due to increased water or swampy conditions (BLM 2018).

3.2.10 Water Resources

Affected Environment

The Arctic climate and permafrost of the Arctic Refuge coastal plain are the controlling physical forces of the hydrologic cycle, and is characterized by low precipitation and below-freezing average temperatures during eight months of the year (Lyons and Trawicki 1994 WRB 94-3). A comparison of average monthly temperatures at Barter Island on the coast and further south in the coastal plain and northern Brooks Range foothills (represented by Kuparuk and Toolik Lake, respectively) are provided in **Table G-1** in **Appendix G,** Water Resources.

Snowfall measurements date back to 1949 on Barter Island, but the monitoring site was taken out of service in 1989, resulting in a discontinuous record of snow climatology. In 2000, three meteorological stations were established (Urban and Clow 2017) as part of the Global Terrestrial Network for Permafrost (DOI/GTN-P) in remote parts of the Arctic Refuge coastal plain. The limited data available from these stations are the only modern continuous record of snow accumulation in this region of Alaska. The available average annual water equivalent of monthly precipitation and snowfall data is provided in **Tables G-2** and **G-3** in **Appendix G**, respectively.

Hydrology

Water resources on the North Slope consist mainly of rivers, shallow discontinuous streams, lakes, and ponds. Hydrology is influenced by climate, topography, and permafrost. Topography of the program area ranges from the steep Brooks Range foothills to relatively flat and poorly drained tundra underlain with continuous permafrost closer to the coast.

Streams on the North Slope typically freeze in September and thaw in June. Due to the climate, the annual hydrologic cycle is dominated by an approximate three-week period of spring breakup associated with snowmelt and overbank and overland flooding. The open water season is generally limited to June through September. While notable fall events have been recorded, annual peak stage (i.e., water level) and discharge in streams is associated with the spring breakup (late May or early June). Runoff from rainfall events during the summer months are generally contained within the river channels.

Streams on the North Slope are generally divided into three types, based on the physiographic province of their origin: those that originate in (1) the coastal plain of the North Slope (a broader area than the program area), (2) the Arctic foothills, or (3) the Brooks Range. Streams and rivers in the program area share flow characteristics that are typical of the region (Brabets 1996). In the winter, stream flow is generally nonexistent or so low as to not be measurable. During freeze-up, ice becomes anchored to the streambed, and in shallow locations the entire water column freezes. River flow begins during spring break up in late May or early June and flooding may occur from rapid snowmelt combined with ice- and snow-filled channels. Spring breakup can inundate extremely large areas in a matter of days. More than half of the annual discharge for a stream can occur during a period of several days to a few weeks (Sloan

1987). Most streams continue to flow throughout the summer, but at substantially lower discharges. Rainstorms can increase stream flow, but they are seldom sufficient to cause flooding within the coastal plain of the North Slope. Stream flow rapidly declines in most streams shortly after the onset of freeze-up in September and ceases in most rivers by December.

The spring season brings about major shifts in hydrology that recharge aquatic habitats and support fish migration. Snowmelt starts earliest in the foothills and then proceeds to the coastal plain. During this time, sheets of snowmelt water flow over frozen ground, extensive fields of aufeis play an important role directing river flow paths over land and into new channels, and snowmelt and flood waters create ephemeral connections between aquatic habitats and recharge floodplain lakes and wet meadow zones. On the North Slope, up to 40 percent of snowmelt serves to recharge the evaporation deficit from the previous summer and immediately following snowmelt, surface waters are at their maximum extent (Bowling et al. 2003). Within two weeks of snowmelt, overland flow ceases and many hydrologic systems become disconnected (Bowling et al. 2003).

Flooding of North Slope rivers is influenced by the type of physiographic region drained, the size of the drainage area, and the air temperatures during breakup. Snowmelt is the main cause of annual flooding in all North Slope rivers and it may be heavy during rapid temperature rises in late May or may occur to a lesser extent over a prolonged period of weeks. Snowmelt flooding nearly always produces the annual peak discharge on rivers in the study area. On some of the larger rivers, summer precipitation or late summer/fall snowmelt events have been observed to produce low magnitude floods. **Table G-5** (**Appendix G**, Water Resources) provides historic data of measured discharge for several rivers within the program area.

Watersheds, Rivers, and Streams

Ten major rivers and numerous smaller streams and rivers flow north from mountain/foothill and tundra watersheds which traverse the Arctic Refuge coastal plain before flowing into the Arctic Ocean. During winter, some rivers may freeze to the bed while others have small pockets of unfrozen water beneath ice hummocks and along spring-fed reaches or exhibit flow sub-bed in unfrozen gravels. At locations where water is forced the surface, extensive fields of aufeis (an expansive mass of layered ice formed by successive freezing of emerging groundwater) may be generated which persist and melt during the summer, providing a continued source of flow. During late May to June, snowmelt begins in the foothills and proceeds to the coastal plain providing as much as 50 percent of the annual flow to rivers (Clough et al. 1987; Sloan 1987). **Table G-3** (**Appendix G**, Water Resources) provides a list of the major drainage basins and waterbodies in the Arctic Refuge coastal plain, their drainage areas, and other characteristics. **Table G-4** (**Appendix G**, Water Resources) provides a list of stream lengths of major streams in the coastal plain.

The majority of the program area is considered wetland; however, lakes are very scarce (less than two percent of the land surface area) compared to the eastern NPR-A where lakes cover approximately 20 percent of the land surface area. Lakes are not evenly distributed across the program area but are concentrated near the mouth of the Canning River and in the region of the Sadlerochit and Jago Rivers with very few lakes occupying the central Katakturuk River region (Trawicki et al. 1991). Lakes vary in surface area from 1,500 acres to less than an acre and 90 percent are less than 12 acres. A study of 115 of the largest lakes indicated most lakes are shallow and freeze to the bottom during winter (Trawicki et al. 1991). The estimated volume of liquid water in these lakes is 1.1 billion gallons by the end of the

winter season. Eighty percent of this volume is concentrated in seven lakes in the Canning River Delta and one of these lakes is known to have salinity concentrations close to that of seawater.

The recharge capacity of many lakes is generally limited to snowmelt and direct precipitation near the lake. Deep lakes also have a larger thermal mass, thus the deeper lakes may remain covered by ice into early July, much later than the shallow lakes (Walker et al. 1978). Some lakes in the program area have been sampled (Trawicki et al., 1991) with some characteristics listed in **Table G-6** (**Appendix G**, Water Resources)

During winter, most waterbodies on the Arctic Refuge coastal plain freeze solid as they are typically not as deep as the depth of freeze reported to be 6-7 feet (Trawicki et al. 1991; Lyons and Trawicki 1994). Small pockets of unfrozen water occur in lakes with depths that exceed ice growth. By the end of the winter season, the volume of liquid water in these lakes has been estimated to be reduced by 98 percent (Craig 1989b). Sellman et al. (1975) concluded that lakes and ponds in this region originated from the thawing of the shallowest, ice-rich permafrost layer. They found that in permafrost near the coast, the upper 10 to 12 feet contained as much as 80 percent segregated ice. Disturbance of the vegetation or water and wind erosion could initiate melting of the upper ice-rich zones and trigger the development of thaw-lakes. Up to 40 percent of snowmelt serves to recharge the evaporation deficit from the previous summer (Bowling et al. 2003), with the remainder coming from direct precipitation.

Groundwater Springs and Aufeis

The perennial springs in the Arctic Refuge coastal plain are unique when compared to the coastal plain to the west, which lacks major spring-fed habitats. Spring-fed reaches maintain relatively stable flows and temperatures year-round, have relatively large productive stands of riparian vegetation, and produce extensive fields of aufeis. Aufeis formations near springs can be 20 feet high and more than 1 mile wide by the end of the winter. Aufeis persists throughout much of the summer season; some spring-fed reaches stay ice-free during the winter and provide critical overwintering habitat for high concentrations of macroinvertebrates and Dolly Varden (Craig 1989a). The most prolific springs within the program area are the Canning, Hulahula, Sadlerochit, Itkilyariak, and Katakturak springs.

In general, usable groundwater is limited to distinct and unconnected shallow zones in the thaw bulbs of rivers and lakes due to the presence of permafrost, which is almost continuous across the North Slope. The frozen state of the soils combined with their fine-grained characteristics and saturated conditions form a confining layer that prevents percolation and recharge from surface water sources and prohibits the movement of groundwater. Because percolation and recharge are restricted, the formation of usable subsurface water resources is limited to unfrozen material on top of the permafrost or taliks (thawed zones) beneath relatively deep lakes, or zones in thawed sediments below major rivers and streams. In general, while these shallow groundwater zones do exist, they are typically very small, and the water is likely unsuitable for drinking and potentially harmful to vegetation when discharged on the tundra surface (BLM 2004a, Section 3.2.2.1). Shallow supra-permafrost water also occurs seasonally within the active zone above the impervious permafrost; the thickness of the active layer is typically 1.5 feet but can range from 1 to 4 feet (Gyrc 1985).

Nearshore Marine

The Beaufort Sea has a narrow continental shelf that extends offshore 31 to 62 miles. Surficial sediments of the shelf consist primarily of mud, with coarser material. The Beaufort shelf is most influenced by

river input, but also affected by processes offshore in the deep basin, such as currents. During the open water season, surface currents are primarily wind driven close to shore. Ice covers the sea for up to 9 months of the year, generally from July to September.

The nearshore environment in the southern Beaufort Sea is a mix of open coast and lagoons bounded by barrier islands. In summer, water along the coast becomes brackish and relatively warm because of flow from the Mackenzie River and other rivers along the eastern Arctic coastline (Craig 1984; Hale 1991; Dunton et al. 2006). The lagoons are relatively shallow, the amplitude of the tides is very small (≤11.5 inches), and waters are considerably less salty and much warmer than sea water.

Water Quantity

Water quantity has been calculated and documented by the U.S. Fish and Wildlife Service (USFWS) (1991). Within four of the regions investigated, there are 119 lakes with an annual ice-free volume of 55,382 acre feet, as summarized in **Table G-6** (**Appendix G**, Water Resources). This volume is reduced to 3,366 acre feet in April when there is approximately seven feet of ice. These values do not represent the total available quantity nor indicate suitable uses of the water (e.g. ice road construction).

Water Rights

The Alaska Department of Natural Resources (ADNR) water rights records indicates there are two water right permits issued to North Slope Public Works and over 360 Instream Reservation completed and pending applications under the USFWS. While the Instream Reservations have not been issued as a water right permit, those applications will have seniority over any new applications received by the ADNR.

Water Quality

Most fresh waters in the program area are pristine; however, fecal contamination above State of Alaska water quality standards may occur in areas with dense avian, caribou, and lemming populations. Cold water temperatures tend to prolong the viability of fecal coliform. Most fresh waterbodies in the program area have low turbidity and dissolved oxygen near saturation. According to the Alaska Department of Environmental Conservation, no fresh water in the program area has been documented as impaired by pollutants (ADEC 2017).

Winter freeze and summer recharge cycles cause contrasting effects in water quality. During winter freezing, major ions (i.e., calcium, magnesium, sodium, potassium, chloride, sulfate and nitrate) and other impurities are excluded from downward-freezing ice and forced into the underlying sediment. Spring snowmelt and resulting water flow across the surface of the ice removes the cover from lakes, allowing the wind to mix the water column throughout the summer. Recharge of lakes through sheet flow during spring counteracts the effects of water loss and ion concentration caused by evaporation in the summer. The net result of the input of snowmelt waters and spring sheet flow in deeper lakes is to refresh their existing water chemistry. The Alaska Department of Environmental Conservation considers a pH range within 6.5 to 8.5 necessary to protect aquatic wildlife. Lakes in the program area generally have lower pH values and higher alkalinity in the winter months, which is reflective of the ice exclusion process (which occurs during freeze-up) (Trawicki et. al. 1991).

Environmental Consequences

Direct and Indirect Impacts

Potential impacts on surface water quality would be similar to those of the NPR-A as described in BLM (2012, Section 4.5.4.2) and BLM (2004, Section 4F.2.2.2):

- Shoreline disturbance and thermokarst (marshy hollows and small hummocks formed by melting permafrost)
- Blockage or convergence of natural drainage
- Increased stages and velocities of floodwater
- Increased channel scour
- Increased bank erosion
- Increased sedimentation
- Increased potential for overbank flooding
- Changes in recharge potential from removal or compaction of surface soils and gravel
- Produced-water spills
- Petroleum hydrocarbon spills
- Demand for water supply

Hydrology and surface water quality are closely linked, and the discussion regarding potential impacts on water resources is combined in this section. Development activities that can impact water resources involve:

- Gravel mining
- Placement of gravel fill for infrastructure (e.g. roads, pads, airstrip)
- Installation of culverts and bridges
- Construction of pipelines and vertical support member (VSM) footers
- Construction of ice roads and pads
- Extraction of water supply from local lakes (for ice roads, construction, drilling and operation)

Avoidance or reduction of potential impacts on water resources would be provided through siting, design, and mitigation. In addition to the stipulations and required operating procedures that are part of the alternatives in **Chapter 2**, project activities that could impact water resources would be subject to federal, state and local permit requirements.

Alternative A

Under Alternative A, no federal minerals in the program area would be offered for future oil and gas lease sales. Current management actions and resource trends would continue, as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015). Changes to water resources would continue to occur along current trends. No direct or indirect impacts to water resources would result from Alternative A.

Impacts Common to All Action Alternatives

Changes in Surface Water Flow

Changes to surface water flow will result from the various aspects of development and include short term, long term, and permanent changes to water resources from exploration, construction and production operations. The effects from these activities vary in intensity involve alterations to stream stage (water level) and velocities, water quality and water volume, and drainage patterns.

Sand and gravel resources would be mined under all three RFD scenarios for construction of pads, roads and air strips (**Appendix E**, RFD Scenario). Removal of gravel from areas near (or within) streams and lakes would change stream or lake configurations, stream hydraulics, lake shoreline flow patterns, erosion, sedimentation, and ice damming (National Research Council 2003). Gravel extraction would cause sedimentation as discussed in BLM (2012, Section 4.5.4.2, pages 12 and 13). No specific gravel mining sites have been identified; however, estimated volumes of the RFD scenarios are summarized in **Appendix E,** RFD Scenario.

The water in a flooded gravel pit would likely remain unfrozen near the bottom, altering the thermal regime and creating a thaw bulb around and beneath the pit, potentially resulting in localized thermokarst. The steep side slopes of excavation pits would likely slough as they thaw, becoming more gradual over time, and causing some slight infilling. Permit-required reclamation plans would be required when the pit is decommissioned.

Exploration and construction associated with the RFD scenarios (e.g., the placement and construction of gravel pads, roads, air access facilities, culverts and bridges) would affect natural drainage patterns (creation of new channels, inundation of dry areas, and starving wetlands of water on the downstream side of roads), stream stage (water level) and stream flow (volume), stream velocity (which influences erosion and sedimentation rates), groundwater flow and lake levels. Modification of the natural surface water drainage patterns would block or redirect flow. Disruption of streambeds and stream banks would remove protective shoreline vegetation and lead to channel erosion and sedimentation, formation of meltwater gullies, plunge pools from perched culverts, and formation of alluvial fans in streams and lakes (BLM 2012, Section 4.4.4.2 page 377).

Examples of construction activities that would impact hydrology include displacement of a lake or pond by fill or placing fill (such as an airstrip or road) transversely across grade, thereby blocking the natural drainage patterns when the snow melts. Placing fill transversely across grade or the predominant wind direction may also change snow accumulation patterns, which, in turn, may change drainage patterns when the snow melts. Impacts on drainage patterns would increase inundation or drying of affected areas. Increased inundation may in turn increase thermokarst action in the affected areas.

Placing gravel fill on tundra would change recharge potential, block natural drainage and change the existing hydrologic regime; erosion of roads and pads would increase sedimentation onto the tundra or into waterways. During construction, sediments and dust would be disturbed and deposited on snow and ice during the winter or on tundra and open water during the summer. The sediments and dust would be introduced into the water column, causing an increase in turbidity and sedimentation. A road or airstrip aligned perpendicular to stream channels and the direction of sheet flow would have a greater potential to impound sheet flow and shallow groundwater than a road or airstrip aligned parallel

to existing drainage patterns. Details related to erosion and sedimentation during the construction phase is provided in BLM (2004a, Section F4.2.2.2).

Development of mining pads, airstrips and roads would be designed to account for thermal criteria (minimum thickness to prevent permafrost degradation) and hydrologic criteria to minimize impacts on the surrounding area.

Where gravel fill is placed in wet areas to construct a road, pad, or airstrip, the receiving waters would temporarily have higher suspended solids concentrations and greater turbidity. Fugitive dust which enters surface water bodies would also increase turbidity and sedimentation. Further information regarding turbidity during the construction phase is provided in BLM (2004a, Section F4.2.2.2).

Culverts would likely be used extensively under all action alternatives for access road water crossings and to provide cross drainage. The design criteria for all culverts is such that they would prevent raising water levels on the upstream side of the crossings. Culverts would be installed at regularly spaced intervals to mitigate the risk of sheet flow interruption and thermokarst action. Final design of culverts depends of the spring ice breakup and snow melt characteristics for those drainages that could affect the road.

The impacts of increased stream velocities through culverts during flooding events are addressed in BLM (2004a, Section 4F.2.2.1). Constricting flows would result in increased stream velocities and a higher potential for ice jams, scour, and stream bank erosion. Impeding flows would result in a higher potential for bank overflows and floodplain inundation. These potential impacts need to be minimized by incorporating design features to protect the structural integrity of the road- and pipeline-crossing structures to accommodate all but the low probability flood events. Once installed, above-ground pipelines would have nearly no effect on stream and water flow characteristics.

The configuration of gravel fills also affects impacts; a linear road running perpendicular to the hydraulic gradient would result in a larger extent of hydrological impacts than a consolidated, square pad of similar acreage. The duration of impacts would be long term because the roads and pads would remain during the period of operation.

Pipeline construction within the program area would have effects on water resources related to the ice road construction and associated water withdrawals from local lakes. Narrow drainages are typically crossed using elevated pipelines on suspension spans. Pipelines would be routed to avoid lakes. Once installed, above-ground pipelines would have nearly no impact on water flow characteristics but would impact water resources in the event of an oil spill.

Impacts on hydrology associated with construction of gravel pads, roads, and airstrip and ice roads would persist through the life of an individual project, including natural drainage patterns, stream stage and stream flow, stream velocity, groundwater flow, and lake levels as described previously. The duration of impacts would be long term because the gravel structures would remain during the period of operation.

Ice roads and ice pads would be used extensively for seasonal vehicle access and could require breaching at stream crossings if fish passage is a concern during spring breakup.

<u>Water Withdrawals</u>

Water withdrawals to support components of the action alternatives would affect the water levels of lakes used as water sources, and any connected water body, such as streams or wetlands. Only permitted lakes, rivers, or reservoirs (under ADNR Temporary Use Authorizations and, if required, ADFG Fish Habitat Permits) would serve as water sources. Typical consumptive water use would involve:

- Seasonal construction of ice roads and pads;
- Drilling, hydraulic fracturing and waterflooding;
- Hydrostatic testing;
- Dust abatement on roads, pads, and airstrips during summer;
- Potable water; and
- Fire suppression and maintenance activities.

Surface water withdrawals for construction uses (ice roads, dust abatement, and operations) would affect shallow groundwater levels, surface water levels, and drainage patterns during the summer season. Lakes would be the principal supply for fresh water during construction. Ice roads and ice pads would be constructed to support construction activities under all action alternatives for access during the winter season. Under all action alternatives, no long term impacts to lakes and ponds are anticipated from ice roads, ice pads, or ice bridges as discussed in BLM (2012, Section 4.5.4.2).

Ice road construction over lakes that do not freeze to the bottom could affect dissolved oxygen concentrations. An ice road which crosses such an intermediate-depth lake could freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen would result. Details related to dissolved oxygen concentrations during ice roads construction are provided in BLM (2004a).

<u>Changes to Surface Water Quality</u>

Changes to water quality could occur during the exploration, construction and operation phases of a future oil and gas development project. Increased turbidity of water bodies would result from dust fallout, flooding, erosion or bank failure. After construction is complete, gravel from roads, pads and airstrips would be the main dust; dust fallout from vehicle traffic could increase turbidity within ponds, lakes, creeks, streams and rivers and wetlands that are adjacent to roads and construction areas.

A direct impact from winter road and pipeline construction would be disturbance of tundra soils and vegetation (see **Section 3.2.8**, Soil Resources and **Section 3.3.1**, Vegetation and Wetlands, respectively). Disturbed and exposed soils are more susceptible to erosion and subsequent sedimentation during spring breakup of ice than undisturbed areas. Fugitive dust from construction could also be deposited on snow and ice during the winter. When melting occurs, this dust can then enter surface water bodies, increasing turbidity.

Fresh water would be withdrawn from lakes within the program area for several primary uses: construction of ice roads and pads, pipeline maintenance, production drilling, and for potable water at camps. Water would also be used for dust control on roads. This water would be recharged in the spring when snow and ice melt increase flow volumes in connected water bodies.

A thorough discussion of the water quality effects resulting from development activities can be found in BLM (2004 Section 4F.2.2.2).

Only treated (secondary treatment) domestic wastewater would be discharged to water bodies/wetlands; it in not anticipated that there would be an increase in fecal coliform counts over the naturally occurring concentrations.

Oil spills could occur from pipelines, storage tanks, production facilities and infrastructure, drill rigs and vehicles during drilling and operation phase. Spills occurring from pipelines or leaving pads and roadbeds could enter water sources reaching tundra ponds, lakes, creeks or rivers. Spills can occur at any time during the year. The potential impacts associated with oil spills are described in **Section 3.2.11**, Solid and Hazardous Waste.

<u>Changes to Groundwater</u>

During gravel mining, it is probable that shallow taliks and supra-permafrost water zones would be temporarily eliminated in the immediate vicinity of a gravel mine. The effect of this loss on water resources is localized and limited to supra-permafrost water zones which would re-establish over time after the mine pit is decommissioned. The subsurface water-bearing zone would be permanently eliminated in the immediate footprint of the mine and would be replaced by surface water that is connected to the shallow groundwater.

<u>Changes to Marine Waters</u>

The is a potential for impacts to marine waters from barge docking sites and seawater treatment plants, primarily in the event of an oil spill. The extent of such contamination would be related to the size, nature and timing of the spill. If a spill were to happen during the open-water or broken-ice seasons, hydrocarbons dispersed in the shallow estuarine water column could exceed acute-toxic criteria during the initial spill period but would be short term and localized. Impacts to marine waters are more thoroughly described in BLM (2018).

Alternative B

Alternative B includes approximately 1.56 million acres available for lease sale. Under this alternative, the Lease Stipulation 1 provides setbacks (0.5 mile to 1 mile) and prohibits (no surface occupancy) permanent oil and gas facilities and supporting infrastructure in the streambeds of the following rivers:

- Canning River
- Hulahula River
- Aichilak River
- Okpilak River
- Jago River
- Sadlerochit River
- Tamayariak River
- Okerokovik River

These actions are designed to minimize the disruption of natural flow patterns and changes to water quality for these specific waterbodies.

Additionally, Required Operating Procedures 3, 4, 9, 10, 12, 13, 17, 20, 24, and 26 would minimize impacts to water resources under Alternative B.

Alternative C

Alternative C includes approximately 1.12 million acres available for lease sale. The Stipulations and Required Operating Procedures for Alternative C would be the same those discussed under Alternative B except for additional protections from Lease Stipulation 9. This stipulation does not allow exploratory well drill pads, production well drill pads, and central processing facilities within coastal waters, lagoons or barrier islands within the boundaries of the Coastal Plain or 1 mile inland from the coast.

Alternative D

Alternative D includes approximately 1.04 million acres available for lease sale, and also provides the most protections for water resources. Lease Stipulation 9 increases the setback distances on rivers from Alternative B, and adds additional rivers to the list for setbacks. There are also seasonal operational restrictions on coastal water bodies or islands between May 15 and November 1, or when sea ice is within the coast of each season. Lease Stipulation 2 reduces impacts to water quality by prohibiting permanent oil and gas facilities and infrastructure within 0.5 miles of the ordinary high water mark of any water body within Townships 8 and 9 north of the Canning and Tamyariak watersheds. Lease Stipulation 3 protects water quality associated with these specific features, and identifies areas that will not be offered for lease sale and/or no surface occupancy would be permitted.

Additionally, Required Operating Procedures 3, 4, 9, 10, 12, 13, 17, 20, 24, and 26 would minimize impacts to water resources under Alternative B.

Cumulative Impacts

The geographic area relevant for assessing cumulative impacts for water resources is the program area. No other past, present, and reasonably foreseeable future actions that could impact water resources have occurred or would occur in the program area.

Climate variability will affect water resources by increasing the frequency and severity of extreme flood events. Snowmelt will occur during a period of lower solar radiation, which could lead to a more protracted melt and less intense runoff. Overall, the magnitude and frequency of high flows will decline while low flows will increase. These effects are described in more detail in the Draft Supplemental Environmental Impact Statement for the Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project (BLM 2018, Section 3.2.4).

3.2.11 Solid and Hazardous Waste

Affected Environment

The Coastal Plain has had limited human or industrial activity that could result in solid or hazardous wastes being introduced into the environment. Kaktovik is the only community in the Coastal Plain; however, it is excluded from the program area boundary under Public Law 115-97. Solid, human, or hazardous wastes identified in the Coastal Plain are related to industrial activities or community development typically along the coast.

Industrial activity consists of past Department of Defense (DOD) Defense Early Warning (DEW) Line facilities and Long Range Radar Sites (LRRS) at Brownlow Point, Collinson Point, Barter Island, Griffin

Point, and Nuvagapak Point. Construction of these facilities began as early as 1947, with the main installations built between 1952 and 1953. Brownlow Point was abandoned in 1958, Collinson Point and Nuvagapak Point were active between 1953 and 1962. Griffin Point was active between 1953 and 1957, and Barter Island White Alice Communications System (WACS) was deactivated in 1979 and replaced with a Minimally Attended Radar in the mid-1980s.

Most of the DOD's cleanup and building demolition occurred in 1994, 2000, and 2006. Community development is associated with public facilities in Kaktovik. Most facilities and sites are on the coast at Brownlow Point, Collinson Point, Barter Island, Griffin Point, and Nuvagapak Point. See **Section 3.4.1,** Landownership and Use, for a further discussion of Kaktovik facilities and DOD facilities and activities.

Table 3.2.11-1 identifies the facilities near the program area that are required to be registered with the EPA for discharges associated with the Clean Air Act or the Clean Water Act.

Table 3.2.11-1
Facilities Registered with the EPA

EPA Registry ID	Facility Name	Description	Location
110067059523	Bill Sands Camp	Mobile camp; various sites	Beaufort Lagoon
110064792112	USFWS Arctic Refuge: Griffin Point DEW Line staging site		Griffin Point
110003039104	Kaktovik Department of Municipal Services	Conditional exempt small quantity generator	Kaktovik
110030898544	Kaktovik Wastewater Treatment Facility	Wastewater treatment facility	Kaktovik
110006878129	US Air Force Long Range Radar Site (LRRS) - Barter Island	Various facilities DEW Line and LRRS	Kaktovik
110006877610	USFWS Nuvagapak DEW Line site		Nuvagapak Point

Source: EPA 2018

Table 3.2.11-2 identifies ADEC authorized solid waste facilities closest to the program area.

Table 3.2.11-2
Solid Waste Facilities

Facility Name	Classification	Location	Status
Kaktovik Landfill	Class III landfill[8]	Kaktovik	Closed
Kaktovik Community Tank Farm	Tank farm	Kaktovik	Active
Kaktovik Barter Island LRRS Hanger	Military	Kaktovik	Active
Kaktovik Barter Island LRRS Refueling Area	Polluted soil	Kaktovik	Active
Kaktovik 1.9 SE Landfill	Class III landfill	Kaktovik	Active
Barter Island LRRS-C&D GP	Inert monofill	Kaktovik	Retired
Barter Island LRRS Biosolids Land Application	Land application site	Kaktovik	Retired
Barter Island (Kaktovik) LRRS (BAR-Main DEWline)	Class III camp landfill	Kaktovik	Retired

Source: ADEC 2018b

[8] Rural landfills often not connected by road to a larger landfill or are more than 50 miles by road from a larger landfill. The landfill serves fewer than 1,500 people.

Table 3.2.11-3 identifies ADEC documented contaminated sites, all of which are shown on **Map 3-9, Hazardous Waste Sites** in **Appendix A**.

Table 3.2.11-3
ADEC Identified Contaminated Sites

ADEC Hazard ID	Site Name	Status
737	Brownlow Point/DERP	Cleanup complete
739	South Barter Island barrel dump	Cleanup complete
752	Barter Island DEW—POL catchment	Cleanup complete
753	Barter Island DEW—old dump site (LF019)	Cleanup complete
754	Barter Island Dew—heated storage (SS013)	Cleanup complete institutional controls
755	Barter Island Dew—garage (SS014)	Cleanup complete institutional controls
756	Barter Island DEW—weather station	Cleanup complete
757	Barter Island DEW—POL tanks	Cleanup complete institutional controls
759	Barter Island DEW—JP-4 spill (SS021)	Cleanup complete
760	Barter Island DEW—old landfill (LF001)	Cleanup complete
761	Barter Island DEW—runway Dump	Cleanup complete
801	Barter Island DEW—contamination ditch (SD008)	Cleanup complete
802	Barter Island DEW—White Alice (SS016)	Cleanup complete
1431	Waldo arms fuel	Cleanup complete
1679	Collinson Point DEW Line—Sitewide	Informational
1681	Griffin Point/DERP	Cleanup complete
1921	Kaktovik Kaveolook School	Cleanup complete
2306	North Slope Borough (NSB) Kaktovik power plant tank farm	Active
2307	NSB Kaktovik tank farm terminal	Active
2327	NSB Kaktovik KIC pad	Active
3085	Barter Island—staging area	Cleanup complete
3825	Jago River drum site	Cleanup complete
4036	Barter Island DEW—air terminal (SS011)	Cleanup complete institutional controls
4037	Barter Island DEW—fuel tanks (ST018)	Cleanup complete institutional controls
4038	Barter Island DEW—dump area NW (LF009)	Cleanup complete
4222	Barter Island LRRS refueling area (CG002)	Cleanup complete
4229	Barter Island LRRS hangar (SS022)	Active
25328	Collinson Point DEW Line POL pipeline corridor	Active
25329	Collinson Point DEW Line AST pad and AST pond	Active
25330	Collinson Point DEW Line Quonset hut #3	Active
25331	Collinson Point DEW Line shop building area	Active
25332	Collinson Point DEW Line composite building area	Active
25333	Nuvagapak Point DEW Line AST pad area	Active
25335	Nuvagapak Point DEW Line dump site D	Active
25336	Nuvagapak Point DEW Line debris pile A (Grid Area)	Active
25337	Nuvagapak Point DEW Line Kogotpak River dump site E	Active
26827	NSB Kaktovik transformer	Active

Source: ADEC 2018a, 2018c

Direct and Indirect Impacts

Direct and indirect impacts resulting from the development and operation of facilities identified in the RFD scenario (**Appendix E**) include the generation of solid waste, wastewater, and spills of oil, salt water, and hazardous substances. Analysis of these impacts are tiered from information contained in three reports (Alpine Satellite Development Plan EIS, Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project Draft SEIS, and the NPR-A IAP/EIS). Updated information from the spills database (**Table 3.2.11-4**) of spills located near Kaktovik, Alaska also supplements the analysis below (ADEC 2018d).

Table 3.2.11-4
ADEC 1995-2018 Database spill records for areas near Kaktovik, Alaska (ADEC 2018d)

Year	Number of Spill Records	Annual Cumulative Spill Volume (gallons)
1996	1	150
1999	3	545
2004	4	621
2005	2	*56 pounds*
2006	1	100
2008	5	2,120
2009	1	75
2010	2	2,456
2011	1	25
2014	3	355
2015	1	5,250
2016	4	201
2017	6	4,415

Source: ADEC 2018d

Spills can originate from pipelines, storage tanks, production facilities and infrastructure, drilling rigs, and heavy equipment or vehicles. Impacts from spills vary based on material type, size, and season.

For this EIS, the materials that could be spilled are categorized and described as follows:

- <u>Produced fluids</u> are composed of crude oil, natural gas, and brine and formation sand.
- <u>Crude oil</u> is oil separated from the brine, natural gas, formation sand, and other impurities and would be transported in the proposed pipeline.
- <u>Refined oil</u> is Arctic diesel, Jet-A 50, unleaded gasoline, hydraulic fluid, transmission oil, lubricating oil and grease, waste oil, mineral oil, and other products.
- <u>Salt water</u> is treated water from the proposed Seawater Treatment Facility.
- <u>Other hazardous materials</u> include methanol, propylene and ethylene glycol (antifreeze), water soluble chemicals, corrosion inhibitor, scale inhibitor, drag reducing agent, and biocides.

Spill impact quantities are categorized and described as follows (taken from BOEM 2004, Section 4.3.2.3):

- Very small spills, less than 10 gallons,

- Small spills, 10 to 99.5 gallons,
- Medium spills, 100 to 999.5 gallons,
- Large spills, 1,000 to 100,000 gallons, and
- Very large spills, greater than 100,000 gallons.

Based on the Alpine Satellite Development Plan for the Greater Mooses Tooth 2 Development Project Draft Supplement Environmental Impact Statement more than half of the North Slope spills were less than 10 gallons and approximately 98 percent of the total volume released resulted from spills larger than 99 gallons (BLM 2014, Section 4.5.2). The probability of a spill over 100,000 gallons is low (BLM 2004, Section 4.3.1)—only three documented spills have been greater than 100,000 gallons (BLM 2014, Section 4.5.2). Upon detection, spills have been promptly contained and cleaned up as required by federal, state, and NSB regulations (NRC 2003).

Spills as a result of the development and operation of facilities identified in the RFD scenario (**Appendix E**, RFD Scenario) would occur on or in close proximity with oilfield infrastructure (BLM 2004, Section 4.3.2.3). Most Alaskan North Slope industry spills have been contained on gravel pads and roadbeds (BLM 2012, Section 4.2.2) and most of the spills that reach the tundra have affected fewer than 5 acres (BLM and MMS 1998). Impacts that have occurred typically were judged to be minor, and natural and/or anthropogenic-assisted restoration have generally occurred within a few months to years (NRC 2003).

The season in which a spill occurs can dramatically influence its behavior, impacts, and the cleanup response actions (BLM 2004, Section 4.3.2.3). In the program area, the active soil layer is 1 to 4 feet thick consisting of poorly drained, unconsolidated sediments, transected by fluvial deposits of rivers and streams. The permafrost is at least 1,000 feet thick except at isolated locations of thaw near deep lakes, springs, or rivers. This would likely prevent the infiltration of oil, salt water, or hazardous substances and affect dispersal of spilled materials, would likely only occur near or at the surface. **Table 3.2.11-5** describes four seasons and potential spill behavior and is taken from the *Alpine Satellite Development Plan Environmental Impact Statement*.

The rate of potential oil, salt water, and hazardous substance spills from the RFD scenario (**Appendix E**) is likely to be lower than the history of the past 30 years of oil exploration, development, production, and transportation on the North Slope. The combination of more stringent agency regulations, continually improving industry operating practices, and advancements in Best Available Control Technology reduce the probability and size of future spills (BLM 2004, Section 4.3.1).

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015). There would be no generation of solid waste, wastewater, or spills of oil, salt water, or hazardous substances within the Coastal Plain associated with actions under Alternative A.

Impacts Common to All Action Alternatives

The RFD scenario (**Appendix E**) identifies a scenario of development activities within the program area and the potential timing of these activities that would require the management of solid waste, wastewater, and hazardous waste.

Table 3.2.11-5
Spill Characteristics by Seasons

Season	Conditions	Description
Summer (Ice-Free)	Most rivers and creeks are ice-free or flowing; ponds and lakes are open water; tundra is snow-free; and biological use of tundra and water bodies is high.	Currents, winds, and passive spreading forces would disperse spills that reach the water bodies. Spills to tundra would directly affect the vegetation, although the dispersal of the spilled material is likely to be impeded by the vegetation. Spills to wet tundra may float on the water or be dispersed over a larger area than would spills to dry tundra or to snow-covered tundra. Spills under pressure that spray into the air may be distributed downwind over substantial areas and impact the tundra vegetation and water bodies.
Fall (Freeze-Up)	Water bodies are beginning to ice over but the ice cover might vary depending upon temperature, wind, currents, and river flow velocities. Snow begins to cover tundra and most of the migratory birds are leaving the North Slope.	Spilled material could be dispersed when it reaches flowing water but slowed or stopped when it reaches snow or surface ice. The spilled material could be contained by the snow or ice but dispersed if the ice breaks up and moves before it re-freezes. The spilled material also could flow into ice cracks to the underlying water where it could collect.
Winter (Ice Cover)	Water bodies are covered by mostly unbroken ice, and snow covers the tundra.	Dispersal of material spilled to the tundra generally would be slowed though not necessarily stopped by the snow cover. Depending upon the depth of snow cover as well as temperature and volume of spilled material, it may reach the underlying dormant vegetation or tundra ponds and lakes. Similarly, spills to rivers and creeks generally would be restricted in areal distribution by the snow and ice covering the water body, compared to seasons when there is no snow or ice cover. Spills under the ice to creeks, rivers, and tundra ponds/lake might disperse slowly as the currents are generally slow to non-existent in the winter.
Spring (Break-Up)	Thawing begins in the higher foothills of the Brooks Range and river flows increase substantially and quickly, often to flood stages. This is a short period of the year. These increased flows cause river ice cover to break-up and flow downriver. River floodwaters usually flow over sea ice, which hastens the break-up of the sea ice. Snow cover begins to melt off the tundra and many migratory species, especially birds, return to the tundra.	Spills to water bodies during break-up are likely to be widely dispersed and difficult to contain or clean up. Spills to the tundra might be widely dispersed if the flooding overtops the river and creek banks, and entrains the spilled material.

All action alternatives would generate solid waste consisting of food wastes, sewage sludge, and other non-hazardous burnable and non-burnable wastes. Solid wastes would be separated and stored in large dumpsters or approved containers, as part of the CPF, until they are incinerated or transported to an

approved offsite landfill(s). Wastes that cannot be incinerated would be transported to approved offsite landfill(s). Burning of waste would temporarily impact air quality.

Injection wells (Class I or Class 2) would be used to dispose of wastewater, produced water, spent fluids, and chemicals as approved by the EPA, the Alaska Oil and Gas Conservation Commission, or ADEC. Injection wells would be used to dispose of wastewater generated from the estimated field use of 2 million gallons per day. As a result, injection of wastewater reduces potential impacts to surface waters or the land by injecting wastewater deep underground into zone isolated from drinking water sources.

The occurrence of spills is not dependent on any alternative chosen, as spills are not a planned activity and are unpredictable in cause, location, size, time, duration, and/or material type (Mach et al. 2000).**Table 3.2.11-6**, taken from the Alpine Satellite Development Plan EIS, describes the relative rate of occurrence for spills from main sources.

Table 3.2.11-6
Relative Rate of Occurrence for Spills from Main Sources

Source Pipeline	Spill Size				
	Very Small (<10 gallons)	**Small (10-99.5 gallons)**	**Medium (100-999.5 gallons)**	**Large (1,000-100,000 gallons)**	**Very Large (>100,000 gallons)**
Produced Fluids	H	H	M	L	VL
Salt Water	H	H	M	L	VL
Diesel	H	M	L	VL	0
Sales Oil	M	M	M	L	VL
Bulk Storage Tanks & Containers of Pads	L	L	L	VL	0
Tank Vehicles	H	M	L	VL	0
Vehicle & Equipment Operation and Maintenance	VH	VH	M	VL	0
Other Routine Operations	VH	VH	H	L	VL
Drilling Blowout	VL	VL	VL	VL	VL
Production Uncontrolled Release	VL	VL	VL	VL	VL

Notes:
VL = Very low rate of occurrence
VH = Very high rate of occurrence
L = Low rate of occurrence
M = Medium rate of occurrence
H = High rate of occurrence
0 = Will not occur

Alternative B

Impacts on solid and hazardous waste under Alternative B would be the same as identified above for all action alternatives.

Alternative C

Impacts on solid and hazardous waste under Alternative B would be the same as identified above for all action alternatives.

Alternative D

Impacts on solid and hazardous waste under Alternative B would be the same as identified above for all action alternatives.

Cumulative Impacts

Cumulative impacts include the existing 34 spills of approximately 16,313 gallons of oils, salt water, or hazardous substances and potential spills from the RFD scenario. These would be considered minor as over half of documented spills associated with oil and gas operations is less than 10 gallons and when detected spills are promptly contained and cleaned up to federal, state, and borough regulations.

3.3 BIOLOGICAL RESOURCES

3.3.1 Vegetation and Wetlands

Affected Environment

The program area encompasses much of the broad, treeless Coastal Plain of the Arctic Refuge, including portions of the northern foothills of the Brooks Range and the Beaufort Sea coast, all between the Canning and Staines Rivers to the west and the Aichilik River to the east (**Map 1-1,** Program Area in **Appendix A**). This area includes portions of two broad ecoregions, the Beaufort Coastal Plain and the Brooks Foothills (Jorgenson and Grunblatt 2013; Nowacki et al. 2001), which are characterized by flat or gently undulating landscapes. Within these two ecoregions are four broad subcategories or eco-subsections: coastal lagoons, lowland peatlands (wet tundra), well-drained colluvium (upland moist tundra), and broad floodplains (shrub thickets) (USFWS 2015; Jorgenson and Grunblatt 2013).

The vegetation mapping available to quantify the coverage of each vegetation type in the program area (**Map 3-10, Vegetation** in **Appendix A**) was prepared by the Alaska Center for Conservation Science (ACCS). This mapping was developed by applying a common hierarchical classification to various data sources (Boggs et al. 2016). The primary data source used was a low resolution map prepared by Ducks Unlimited, Inc. (2013). The advantage of using the ACCS map is that the vegetation classes are easily recognizable and relate well to the classes described in the commonly used Alaska Vegetation Classification (Viereck et al. 1992).

Table H-7 in **Appendix H** provides estimates of the area covered by each vegetation class, based on the land cover mapping reproduced for the program area in **Map 3-10, Vegetation** in **Appendix A**. The vegetation type descriptions below were developed using data sources that provide information at the plant community level for vegetation types on the Coastal Plain (Viereck et al. 1992; USFWS 2015a).

The program area is largely undisturbed, and the most significant existing threat to ecosystem health is climate change (BLM 2018 GMT2). Increased average temperatures may lead to overall drying and subsequent shifts in plant community composition. Permafrost melt may increase thermokarst, exposing mineral soil and resulting in permanent changes in drainage and vegetation.

Dwarf Shrub

Dwarf shrub and dwarf shrub-lichen, combined, encompass less than 1 percent of the program area (**Table H-7** in **Appendix H**). Dwarf prostrate shrub communities (shrub heights of less than 8 inches) have a dry to moist moisture regime. Dry sites are characterized by lichens or bare ground, or both, throughout the understory, whereas moist sites tend to support grasses, sedges, and mosses throughout

the understory. Dry dwarf shrub typically occupies raised and well-drained topographic features on the Coastal Plain, such as steep riverine banks and alluvial fans that accumulate little snow during winter. Moist sites generally have less topographic relief and deeper snowpack that protects the vegetation from abrasion and desiccation by winter winds (USFWS 2015a).

The individual shrub species characterizing both dry and moist sites are similar, dominated primarily by *Dryas* spp., *Arctostaphylos rubra*, *Salix reticulata*, *S. rotundifolia,* and *Cassiope tetragona*. Dry sites support herbaceous species, including *Saxifraga hirculus*, *Polygonum bistorta*, *Petasites frigida*, *Polemonium boreale*, *Equisetum arvense*, *Carex* spp., *Festuca* spp., *Hierochloe* spp., *Epilobium latifolium*, and *Geum glaciale*. Lichens, such as *Cetraria* spp., are also common. Moist sites are also dominated by *Dryas* spp. but also support wetland sedges (*Carex bigelowii*, *C. aquatilis*, and *Eriophorum vaginatum*), horsetails (*Equisetum arvense*), and mosses (e.g., *Tomenthypnum nitens*) (USFWS 2015a).

Low and Tall Shrub

Tall shrub (open-closed) communities are most often associated with riparian zones along rivers and streams and account for less than 1 percent of the program area (**Table H-7** in **Appendix H**). Shrub heights in tall shrub communities are variable, ranging from lows of 8 to 60 inches and heights from 60 to 118 inches. Shrub density also varies, depending on the frequency of overbank flooding and drainage of the substrate. The low and tall shrubs are primarily deciduous, dominated by willow (*Salix* spp.). Common individual willow species are *S. alaxensis*, *S. lanata*, *S. richardsonii*, *S. glauca*, *S. brachycarpa*, and *S. hastata*. The understory often includes a variety of dwarf shrub and herbaceous vascular plants, including *Arctostaphylos rubra*, *Salix reticulata*, *Shepherdia Canadensis*, *Dryas integrifolia*, *D. dummondii*, *Equisetum arvense*, *E. variegatum*, *E. scirpoides*, *Carex* spp., *Juncus castaneus*, *Petasites frigida*, and *Hedysarum* spp. (USFWS 2015a).

Low shrub communities (8 to 60 inches high) also occur in riparian zones and in the larger expanses of tussock-shrub tundra in upland areas. This community accounts for 15 percent of the program area (**Table H-7** in **Appendix H**). This community usually has an open canopy of mixed deciduous species, such as *Salix pulchra*, *Betula nana,* and *Vaccinium uliginosum*. Low shrub communities occupy low-lying basins or toeslopes and are often associated with moist sedge tussock tundra. Found among these communities are *Eriophorum vaginatum*, *Ledum decumbens*, *Vaccinium vitis-idaea*, *Cassiope tetragona,* and *Empetrum nigrum* (USFWS 2015a).

Moist Herbaceous Meadow

Moist herbaceous vegetation types are dominated by graminoids[9] and forbs,[10] often growing alongside dwarf shrubs. Moist herbaceous vegetation is the most common, growing on reasonably well-drained but low-lying Coastal Plain substrates. Surface indicators of permafrost in the form of polygon-patterned ground are often present. The raised centers or raised ridges of polygons support moist tundra habitats, while the low troughs or basins support wet herbaceous types (see *Wet Herbaceous Meadow*, below) (USFWS 2015a).

Moist herbaceous types include herbaceous (mesic) and tussock tundra (low shrub or herbaceous); combined, these types account for 57 percent of the program area (**Table H-7** in **Appendix H**). These

[9] Grass-like plants, including sedges and rushes
[10] Herbaceous, broad-leaved, vascular plants

moist herbaceous communities are dominated by wetland sedges, such s *Eriophorum angustifolium* and *Carex aquatilis*. Also dominating are dwarf shrubs, such as *Salix pulchra*, *S. reticulata,* and *Dryas integrifolia*. The tussock tundra type ranges from herb dominated to low-shrub dominated. In the program area, herb-dominated tussock tundra is more common on the broad, low-lying Coastal Plain, and the low-shrub dominated type is more common inland in the Brooks Range foothills. Tussock tundra is dominated by the tussock forming sedge *Eriophorum vaginatum*. Also dominating are the typical range of deciduous and evergreen, ericaceous shrubs (*Salix reticulata*, *S. pulchra*, *Betula nana*, *Dryas integrifolia*, *Vaccinium uliginosum*, *V. vitis-idaea,* and *Ledum decumbens*) (USFWS 2015a).

Wet Herbaceous Meadow

Wet herbaceous vegetation types include freshwater and brackish water aquatic (marsh) vegetation and saturated and seasonally flooded freshwater wetlands. The herbaceous (wet-marsh) (tidal) and herbaceous (marsh) types combined account for less than 2 percent of the program area (**Table H-7** in **Appendix H**). The most common freshwater species is the grass *Arctophila fulva* in deeper water, with *Carex aquatilis* and *Eriophorum angustifolium* occupying shallower lake fringe zones. Salt tolerant marsh species in the tidal areas include *Puccinellia phryganodes*, *Carex subspathacea,* and *Dupontia fisheri* (USFWS 2015a).

The herbaceous (wet) vegetation type accounts for 17 percent of the program area and is primarily found in low-lying drained lake basins, intermingled with moist tundra where the surface is patterned with polygons, with limited occurrence on headwater stream floodplains (**Table H-7** in **Appendix H**; USFWS 2015a). The most commonly occurring species are *Carex aquatilis* and *Eriophorum angustifolium*. Trace amounts of forbs and dwarf shrubs may be present, suh as *Pedicularis* spp., *Valeriana capitata*, *Polygonum* spp., and *Salix fuscescens* (USFWS 2015a).

Barrens

The barren type occurs on approximately 1 percent of the program area (**Table H-7** in **Appendix H**). Plants are scattered or absent, and bare soil is the dominant feature. This land cover type is most commonly found in the program area on exposed riverine surfaces or intertidal beaches as well as on limited areas at higher elevations in the Brooks Range foothills.

Other

The freshwater or saltwater type comprises 9 percent of the program area, primarily consisting of nearshore water in the coastal lagoons between the mainland and the barrier islands (**Table H-7** in **Appendix H**). Freshwater lakes and ponds comprise a smaller proportion of this type, mostly concentrated in the river deltas and within abandoned floodplains, where flooded oxbow lakes are common.

Rare Plants

There are no federally listed, threatened, or endangered plant species known to occur in the program area. The ACCS maintains a listing of ranked sensitive species in Alaska, manages a database of rare plant occurrences, and provides updates to a rare plant field guide (ACCS 2018). To obtain a preliminary listing of rare plants, the BLM searched the ACCS rare plant occurrence database for all known records in the program area; this search resulted in 14 vascular plant species with Alaska State rankings, 5 of which are BLM watchlist species and 4 that are BLM sensitive species (**Table H-8** in **Appendix H**).

The BLM monitors a list of 31 vascular plant species that are considered rare on the North Slope, including in the Coastal Plain of the Arctic Refuge (Cortés-Burns et al. 2009). Based on the presence of appropriate habitats, there are 19 additional taxa on the BLM list (not already discussed under documented occurrences above) that could occur in the program area.

Nonnative and Invasive Plants

The spread of nonnative plants is limited on the North Slope of Alaska due to the short growing season and low summer temperatures (Carlson et al. 2015). Historically, the region has been thought as a low-risk area for invasive plant infestations. Disturbance vectors for transporting propagules[11] to remote locations on the North Slope are still limited but are expected to increase with industrial development in remote areas, such as the program area. Vector pathways for invasive plants are closely tied to human disturbance, primarily at regional airport hubs, along road and highway corridors, and in areas with foot traffic (Carlson et al. 2015; AKEPIC 2018). With a warming climate and an increase in commercial activity on the North Slope, damage caused by invasive plants is expected to increase in the coming decades (Carlson and Shephard 2007; Carlson et al. 2015)

A review of Alaska's statewide invasive plant database, the Alaska Exotic Plant Clearinghouse (AKEPIC 2018), revealed no documented occurrences of nonnative plant species in the program area. The search area was expanded to the broader Coastal Plain and Brooks Range foothills, where infestations were documented along the Dalton Highway and at Umiat (AKEPIC 2018): Canada thistle (*Cirsium arvense*), narrowleaf hawksbeard (*Crepis tectorum*), herb Sophia (*Descurainia sophia*), white sweetclover (*Melilotus albus*), common dandelion (*Taraxacum officinale*), and foxtail barley (*Hordeum jubatum*). The infestations were associated primarily with such disturbances as fill importation or extraction associated with the construction of gravel roads and pads.

According to the ecological risk analysis conducted by Carlson et al. (2015), none of the documented species listed above are regarded as a significant threat. The species with the greatest ecological risk is thought to be *Hordeum jubatum,* which may be an Alaska native plant. It has been spreading rapidly through the state over recent decades in straw and agricultural seed (Carlson et al. 2015). *Hordeum jubatum* is a salt-tolerant plant with extreme cold tolerance and is capable of invading a range of Coastal Plain ecosystems, including coastal-influenced plant communities. It thus has some potential to spread along with development in the program area.

Wetlands

The BLM used coarse-scale National Wetland Inventory (NWI) mapping for the North Slope of Alaska to assess the extent of wetlands and the wetland types in the program area (USFWS 2018). Most of this landscape is considered to be jurisdictional wetland (USFWS 2018); NWI data indicate that at least 96 percent of the program area is indeed classified as wetland (**Table 3.3.1-1**; **Map 3-11, Wetlands** in **Appendix A**). Upland areas that do not meet the three-parameter criteria to be classified as a wetland (Environmental Laboratory 1987; USACE 2007). These areas are rare and limited to well-drained ridge crests and other exposed areas that are typically blown free of snow in the winter; they accumulate little moisture throughout the year (see the descriptions of dry dwarf shrub and bare ground types in **Section 3.3.1**, Vegetation and Wetlands).

[11] A structure that can detach from a plant and become a new plant, such as a bud or spore.

Table 3.3.1-1
Wetland types mapped in the Arctic Refuge Program Area by the National Wetland Inventory program

Wetland Class	Area (acres)	% of Program Area
Estuarine and Marine Deepwater	71,300	4.5
Estuarine and Marine Wetland	9,700	0.6
Freshwater Emergent Wetland	1,258,300	80.5
Freshwater Forested/Shrub Wetland	98,000	6.2
Freshwater Pond	5,700	0.4
Lake	12,300	0.8
Riverine	53,500	3.4
Unmapped or upland	54,700	3.7
Total area	1,508,800	100.0

Source: USFWS 2018

Elsewhere, the combination of continuous permafrost, which impedes drainage, riverine flooding, and tidal influences account for most of the hydrogeomorphic processes driving wetland development in the program area. Small pockets of isolated and unconnected wetlands may be present on raised, well-drained slopes, dry riverbanks, and remnant dune geomorphic types; however, such areas will require ground-truth surveys to confirm jurisdictional status before development.

In the NWI mapping, 81 percent of the acreage in the program area is classified as freshwater emergent wetland (USFWS 2018); this includes the freshwater herbaceous marsh and herbaceous wet meadow types described in **Section 3.3.1**, Vegetation and Wetlands. Marine waters wetland types account for 5 percent of the program area and occur in the lagoons between the mainland and the barrier islands. Freshwater lakes and ponds comprise less than 2 percent of the area, riverine wetlands cover another 3 percent, and other freshwater wetlands account for 6 percent.

As noted in **Section 3.3.1**, the program area is largely undisturbed, and wetland structure and function is intact. Climate change poses the most significant threat to wetland health (BLM 2018, USFWS 2015a). Lake and wetland habitats have shown a drying trend in the past decade which is predicted to continue. Higher temperatures and a longer growing season increases the water deficit (evapotranspiration far exceeds precipitation) drying lakes and all wetland types. Increased permafrost melt is also predicted to increase drainage causing further drying of wetlands and waters (USFWS 2015a).

<u>Wetland Functions</u>

Most of the land cover types in the program area are likely to be jurisdictional wetlands subject to permitting under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. Because wetlands are ubiquitous in the area, any development project proponent will find it difficult to avoid the loss of wetlands from fill. In such cases, under the mitigation rule of 2008 (33 CFR 320(r)(1)), compensatory mitigation is required for the loss of wetland functions. To quantify the extent of mitigation required, wetland functions are often evaluated so that project designers can avoid the most important wetlands and to determine a compensation ratio if an in-lieu fee is required.

Wetland functions are the ecological services a wetland provides to human communities and ecosystems. Typically, wetland functions are not measured directly, but the degree to which a function is being performed can be correlated with measurable physical characteristics through field observations or aerial photo interpretation.

Statewide, Alaska has very few formally developed and regionally specific methods to systematically quantify wetland functions. Recently, however, the USACE developed a wetland conditional assessment method for the North Slope (Berkowitz 2017). It standardizes the calculation of mitigation compensation metrics. The method is most suitable in areas where development has already occurred and may be useful only in the development phase; however, this is the first method to use a North Slope-specific land cover classification and assess regionally specific wetland conditions.

The most commonly assessed functions for North Slope wetlands are flood flow regulation, sediment nutrient and toxicant removal, erosion control and shoreline stabilization, organic matter production and export, threatened and endangered species support, avian and mammal habitat suitability, fish habitat suitability, educational-scientific-recreational-subsistence use, and maintenance of soil thermal regime. In general, the functions that show the greatest variability among wetland types are those that support wildlife and fish habitat. This is because the measurable indicators of wetland function—the numbers of species and numbers of individual animals that use specific wetland or habitat types—can be wide ranging.

Relative to wetlands in temperate regions, North Slope wetlands tend to have low function for most of the hydrologic, biogeochemical or social functions because of the short, cold growing season, harsh winter conditions, remote location and low human population and ubiquitous impermeable permafrost layer preventing groundwater flow. The most important functions tend to be related to wildlife habitat value and endangered species support. The most common wetland type (Freshwater Emergent Wetland, 80.5 percent of the program area) is comprised of multiple fine scale wetland types ranging from drier, well-drained saturated wetlands to permanently flooded marshlands. The wetter wetland types within this broad class are equivalent to the Herbaceous (Wet), Herbaceous (Marsh), and Herbaceous (Wet-Marsh)(Tidal) (**Table H-7** in **Appendix H**) which provide breeding and nesting for a variety of avian species and spawning and rearing habitat for fish where adjacent to waters.

Direct and Indirect Impacts

Potential direct and indirect impacts to vegetation and wetlands were evaluated for all areas available for development under each alternative as identified in **Chapter 2**, and for areas of high, moderate, and low hydrocarbon potential (HCP) (**Tables H-9 through H-14** in **Appendix H**). The vegetation and wetland types most vulnerable to specific impacts were identified through a review of the scientific literature. As a proxy for a geographically explicit project footprint, potential impacts to the most vulnerable resources were identified by calculating the proportions of vegetation and wetland types occurring within each land-use stipulation category and HCP. The direct footprint for one anchor development unit (consisting of a CPF, roads connecting to six satellite drill pads, a Seawater Treatment Plant pad, and a 30-mi access road) was estimated at approximately 750 acres. The anchor development footprint was buffered by 328 feet (comprising another 5,630 acres) to account for the area of indirect effects on vegetation and wetlands.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the program area would be offered for future oil and gas lease sales. Alternative A would not include the direction under the Tax Cuts and Jobs Act of 2017 to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain within the Arctic Refuge. Under this alternative, current management actions would be maintained and resource trends would continue as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015). There would be no direct or indirect impacts on vegetation or wetlands under Alternative A.

Impacts Common to All Action Alternatives

<u>Exploration</u>

Seismic exploration is proposed to occur during winter with direct surface impacts occurring by passage of camp trains on skis pulled by a tracked trailer directly over the snow-covered tundra surface (**Appendix E**, RFD Scenario). Impacts to vegetation and wetlands typically includes changes in plant community structure for altered hydrology or direct damage to above ground structures such as tussocks or woody stems and branches. Long term studies have shown that the overall impact of seismic vehicle traffic on tundra is low, but impacts can still be measured up to 15 years after exploration. Impacts were shown to affect drier, well-drained, woody shrub vegetation types to a greater degree than wetter types dominated by sedges. The vegetation types most vulnerable to seismic exploration disturbance in the Program Area include: Dwarf Shrub, Low Shrub, and Tussock Tundra. Wetlands most vulnerable to seismic train impacts include the fine-scale types under the broad category of Freshwater Forested/Shrub wetlands. Seismic camp train trails on the North Slope were found to be visible in summer vegetation up to 5 years after disturbance, and the longer-term impacts involved limited ground subsidence where the trail became a wetter trough (Jorgenson et al. 2003; Jorgenson et al. 2010; Yokel and Ver Hoef 2014). Studies on best management practices for winter off-road vehicle traffic suggest that the impacts as described above could be mitigated somewhat by using vehicles with less pounds per square inch and performing seismic operations later in the winter when there is more snow cover and frozen soils (Bader and Guimond 2004; Bader 2005).

Ice roads and pads are remade each year to support exploration drilling. The ice roads and pads are created by pumping water or collecting ice chips from nearby natural freshwater sources. According to a long-term study on the effects of ice road construction and operation in the NPR-A, ice roads have a minimal effect on the vegetation and will recover to pre-construction conditions after approximately 20 years. Similar to seismic train impacts, ice roads disturb the drier, shrub-dominated vegetation types more than wetter graminoid-dominated communities. The damage was found to be due to the freezing of plant tissues in species not adapted to winter freeze and the clipping of high microsites such as raised tussocks that form in Tussock Tundra or shrub branches in low shrub vegetation types (Guyer and Keating 2005). Best management practices include building ice roads along the wettest routes and avoiding clipping of vegetation above the ice surface. The most vulnerable wetland types to ice road construction and use are within the broad category of Freshwater Forested/Shrub wetlands.

<u>Construction</u>

The primary impact to vegetation and wetland types from project construction is permanent loss of these areas due to the placement of fill for the construction of roads, pads, and VSMs for pipeline

footings. The removal of surface layers for gravel extraction in material sites also results in permanent loss of vegetation and wetlands. No vegetation or wetland types are more/or less vulnerable to gravel fill, but the routing for roads and pads is preferentially located through drier vegetation types such as Tussock Tundra, Herbaceous (Mesic) Tundra, and Low Shrub. Ice roads and pads also continue to be used during the construction phase to transport and stockpile materials. The effects would be the same as listed in the Exploration section above.

During construction, vegetation and wetland plant community composition can be altered through the deposition of dust and gravel spray from vehicle traffic; alterations to drainage patterns from drifted snow; impounded drainages; the potential for introduction of invasive or noxious non-native plants; and oil, water, and drilling mud spills to the tundra surface (see **Section 3.2.11**, Solid and Hazardous Waste, for a discussion of spills. Dust fallout due to traffic on gravel road surfaces has been shown to occur up to 328 feet from the edge of the footprint (Myers-Smith et al. 2006). Dust particles may reduce plant growth by smothering the vegetation and may reduce wetland function by introducing pollutants. Gravel roads and pads tend to increase the occurrence of thermokarst directly adjacent to the footprint edge. Thermokarst results in ponded areas extending into the tundra and altering the vegetation and wetland plant community structure. Ponding also may occur if existing subsurface drainage is impeded at the edges of roads or if changes to patterns of snow drifting causes increases in meltwater. Invasive species infestations are a growing threat to the relatively pristine vegetation and wetland types on the North Slope and within the program area. Gravel sources and vehicle tracks contaminated with invasive plant propagules have been shown to be the most likely way for invasive plants to be dispersed (Carlson and Shephard 2007).

<u>Operations</u>

Impacts during project operations could include all effects described for project construction except for the placement of fill and gravel extraction.

Rare plants with documented occurrences within the program area occur broadly across all vegetation types except for aquatic resources including fresh and saltwater and freshwater and estuarine marshes (see Affected Environment above). The available data are not sufficient to determine the range of individual taxa across the program area, thus impacts to rare plant populations are assumed to be equivalent across all alternatives.

Alternative B

Alternative B is designed to protect individual resources and include areas designated as OG-NSO (no surface occupancy within riparian areas, but where roads, pipelines, and bridges are permitted at selected crossings), OG-SaleSTC (subject to standard terms and conditions) and OG-TL (subject to timing limitations areas based on caribou calving and post-calving habitat). The most common vegetation type across all stratified areas available for lease under Alternative B is Herbaceous (Mesic) tundra (ranges from 21.9 percent to 54.7 percent of the area, (**Table H-9** in **Appendix H**). The exception is no surface occupancy areas within the high HCP zone, where Herbaceous (Wet) tundra is the most common vegetation type and accounts for 29.0 percent of the area. The no surface occupancy requirements under Alternative B restrict construction of permanent oil and gas facilities except under circumstances when stream or river crossings are unavoidable; thus the disturbances mentioned above will likely occur throughout the OG-NSO/high HCP area but to a lesser extent than on the OG-SaleSTC or OG-TL areas. The NSO protections preferentially preserve wetter more vulnerable

vegetation types common to riparian areas because impacts are limited to approved crossings and because well pads and central processing facilities may not be constructed. The OG-SaleSTC and OG-TL land-use areas closely match the proportion of vegetation types throughout the entire program area (**Table H-7** in **Appendix H**) and overall may be preferable for construction of gravels roads and pads because they are dominated by drier types such as Tussock Tundra and Low Shrub. The OG-TL leasing area (comprising inland areas of caribou calving and post-calving habitat) within the low HCP notably has the highest proportion of Low Shrub (30.4 percent of the area, see **Table H-9** in **Appendix H**), which is higher than the overall proportions in the program area. The specific stipulations under OG-TL restrict construction between May 15 and July 30 as a consideration for caribou calving and post-calving habitat; this restriction, however, will not preserve vulnerable wetland types because the Arctic growing season lasts beyond the July 30 end date. Because of the higher incidence of Low Shrub vegetation, potential winter seismic and ice road impacts as described under *Impacts Common to All Action Alternatives* would occur on the OG-TL area under Alternative B.

The predominant wetland type within all areas open for leasing under Alternative B is Freshwater Emergent (ranging from 0.1 percent to 95.7 percent of the area (**Table H-10** in **Appendix H**). This broad category includes wetlands with a range of hydrologic conditions from marsh to saturated classes. The wetter classes are often higher functioning wetland types but are merged into a common broad category in this analysis. The NWI mapping provides information on high-value Estuarine and Marine Deepwater wetlands and waters, which typically provide high-value function as habitat for a variety of estuarine specialist avian species. The OG-SaleSTC area within all HCP zones includes a relatively high proportion of estuarine and marine habitats (**Table H-10** in **Appendix H**). As described in the *Affected Environment* section above, the estuarine wetlands in the program area tend to be wetter marsh habitats exposed to saltwater that are high value primarily because they provide high value wildlife habitat. The high value freshwater wetland habitats that are encompassed in the Freshwater Emergent Wetland class (**Table 3.3.1-1**) have moderate protection through the construction limitations to rivers and streams but the high value estuarine wetlands do not have similar protections under the stipulations of Alternative B.

Alternative C

The stipulations for Alternative C are designed similarly to Alternative B. In general, the most common vegetation types within areas available for lease under Alternative C are Herbaceous (Mesic) (ranging from 16.2 percent to 54.7 percent of the area) and Tussock Tundra (ranging from 2.4 percent to 32.3 percent of the area (**Table H-11** in **Appendix H**). The exception is the OG-NSO land-use area within the high HCP zone where Herbaceous (Wet) tundra (29.0 percent of the area), Freshwater or Saltwater (20.7 percent of the area), and Sparse Vegetation (19.9 percent of the area) are the dominant broad-scale vegetation types (**Table H-11** in **Appendix H**). The vulnerable wet tundra types within the NSO riparian areas under Alternative C are protected to a limited extent depending on the specific design of the anchor development and whether crossings are approved. Protections on barrier islands and selected coastal areas for barge landings and docks primarily affect the Sparse Vegetation category, which is most likely comprised of barren gravel/sand beaches and dune geomorphic types.

The relative proportions of wetland types throughout the areas open to leasing under Alternative C are generally equivalent to the overall proportions mapped in the program area with Freshwater Emergent Wetlands accounting for the greatest areal coverage throughout. The OG-NSO requirements for

Alternative C effectively protect high-value estuarine wetlands (see discussion in Affected Environment above, and under Alternative B).

Alternative D

Alternatives D1 and D2 are the most restrictive lease sale scenarios with the highest overall acreages occurring within the OG-NSO across all HCP zones, as well as large areas of caribou calving habitat and spring aufeis areas not offered for leasing in the southeastern corner of the program area (**Table H-13** in **Appendix H**). Restrictions on the OG-NSO include riparian areas, coastal areas, caribou calving habitat, polar bear denning river habitat, spring aufeis, Canning River Deltas and Lakes, and the Wilderness boundary (see **Chapter 2**). The restrictions on the OG-NSO offer limited protection to common or high-value vegetation types in the area except for the Wilderness boundary stipulation, which does not allow development within 3 miles of the southern and eastern boundaries of the program area where they are adjacent to designated Wilderness.

The most common vegetation types within the OG-NSO/High HCP area include: Herbaceous (Mesic) (24.6 percent of the area), Freshwater or Saltwater (23.7 percent), and Herbaceous (Wet) (22.5 percent) (**Table H-13** in **Appendix H**). The area identified under the Wilderness Stipulation where no development is allowed is farther inland and dominated by relatively low-value Tussock Tundra. The OG-CSU land-use category is subject to timing limitations for caribou post-calving habitat and has no effect on the preservation of high-value vegetation types occurring within that area. The timing limitations for both Alternatives D1 and D2 have no effect on the preservation of vulnerable vegetation types. The Wilderness Stipulation provides the only full protection to all vegetation types because no development is allowed within these boundaries (see **Chapter 2**).

The majority of the high-value Estuarine and Marine Deepwater wetlands occur within the OG-NSO land-use category as described above; stipulations will provide limited protection for wetlands by limiting permanent loss.

Cumulative Impacts

The cumulative impacts analysis identifies six categories of disturbance occurring on Alaska's North Slope in the past, present, and reasonably foreseeable future actions to evaluate for contributions to cumulative impacts (**Appendix M**). Oil and gas exploration, development and production, surface transportation, and community development all include the placement of fill resulting in the permanent loss of vegetation and wetlands and indirect effects resulting from the placement of fill as described under *Impacts Common to All Action Alternatives*. Subsistence activities, recreation and tourism, and scientific research are not expected to contribute to the overall loss of high-value vegetation or wetlands within the region.

Climate change may be the most significant cumulative impact to vegetation and wetlands within the program area. Measurable effects have already been documented and are projected to continue along the trends (USFWS 2015a).

3.3.2 Wildland Fire

Affected Environment

Wildland fire has not been recorded in the program area based on available records (USFWS 2015, 2008); as such, the area of analysis for wildland fire has been expanded to include data from similar areas

to the west and south, specifically, the North Slope and the area between the program area and the northern foothills of the Brooks Range. The potential for naturally occurring wildland fire in the program area has been assessed as low, due to climatic conditions, geographic position, and existing vegetation communities (USFWS 2015; Innes 2013).

The North Slope Rapid Ecoregional Assessment (REA) describes fire frequency and fire return intervals over a geographic region that includes the program area. The North Slope REA modelling predicts a low but increasing fire frequency, mainly in the Brooks Range outside of the program area and predicts that wildfire is likely to remain absent or nearly so in the program area (Trammel et al. 2015). A separate analysis in the Arctic Fire Management Plan (FMP) also describes the fire return interval for wildland fire in the program area using the Canadian Forest Fire Danger Rating System (CFFDRS) (USFWS 2008). Using mapped vegetation communities that are grouped into ecological zones, the CFFDRS predicts the fire return interval for ecological zones in the program area to be in the thousands of years (USFWS 2008).

Records of wildland fires on the Arctic Refuge have been kept since 1950 and may indicate that the frequency of wildfires on the Arctic Refuge is increasing (USFWS 2008). From 1950 through 1987, when only fires greater than 1,000 acres were recorded, Arctic Refuge fire frequency averaged 0.37 fires per year (USFWS 2008). From 1989 through 2007, when fires greater than 100 acres were recorded, Arctic Refuge fire frequency averaged 1.68 acres per year (USFWS 2008). The frequency of wildland fires on the Arctic Refuge may be due to a change in recordkeeping (recording 1,000 acres versus a minimum of 100 acres) or an increase in improved observation and mapping technologies; or fire frequency may in fact be increasing in recent years (USFWS 2008).

There have been only eight known occurrences of tundra fires on the North Slope from 1955 to 2006 (Jones et al. 2009). In 2007, the Anaktuvuk River Fire (ARF), the largest North Slope wildfire on record, burned a 386-square-mile swath of tundra in the central Arctic Foothills (USFWS 2015). The ARF occurred during conditions of record high summer temperatures, record low summer precipitation, a late-season high pressure system, extremely dry soil conditions, and sustained southerly winds (Jones et al. 2009). While the environmental factors that contributed to the ARF were extreme, it provides another example of changing conditions that support larger and more severe wildland fires at high latitudes and that may be expected to continue under future climate change scenarios (Jones et al. 2009).

Management of wildland fire in the program area is outlined in the USFWS Arctic Fire Management Plan. It prescribes management direction, based on the geographic boundaries of fire management units (USFWS 2008). The program area is in the Arctic Fire Management Unit (FMU) and is managed under the Limited Fire Management Option. Under this option, minimizing acreage burned is not a management strategy and surveillance is generally the suppression option used on naturally ignited fires (USFWS 2008). Wildland fire use is permitted in the Arctic FMU but prescribed fires are not generally used in this FMU (USFWS 2008). Fire suppression priorities, such as real property and historic or cultural resources, have not been identified in the program area; no properties on the Arctic Refuge are listed on the National Register of Historic Places (USFWS 2008).

Direction on managing wildland fire is also provided in the Arctic Refuge's Comprehensive Conservation Plan (CCP) (USFWS 2015). The CCP indicates that the desired future condition of the Arctic Refuge, in relation to fire, is to enable the natural fire regime to maintain biological integrity, diversity, and

environmental health, without dictating any specific percentage of individual habitat types (USFWS 2015). The CCP management of wildland fire also indicates that continuing its policy to maintain fire-related ecological processes will continue, even under the expected drier conditions and higher temperatures predicted to accompany forecasted climate change scenarios (USFWS 2015).

Vegetation is a factor in wildland fire size, severity, and frequency. Vegetation types and acreages are provided in **Section 3.3.1**, Vegetation and Wetlands, and in the LANDFIRE database (LANDFIRE 2008). The dominant vegetation community in the program area is arctic tundra (which correlates to the Coastal Plain Tundra ecological zone). The discussion of this vegetation community is limited to the characteristics that influence wildland fire (USFWS 2008). The arctic tundra vegetation community is described in detail in Innes (2013).

Fires in arctic tundra are typically ignited by lightning when the rare occurrence of a thunderstorm coincides with dry periods of sufficient length to produce burnable fuels. This is usually a period of only 1 to 3 days per year, usually from May through August (Innes 2013). The fire return interval in tundra ecosystems ranges from 50 to 10,000 years (Gabriel and Tande 1983). Vegetation communities can influence fire frequency by the amount of surface fuels that they contribute. In tundra communities, fuels accumulate rapidly; this is because the grasses and sedges that dominate the ecosystem recover rapidly and produce surface fuels that can carry new fires (Innes 2013).

The rate of vegetation recovery also influences wildland fire return. In tundra communities, severe fires that consume the vegetation and the organic soil layer will take decades or longer to recover. In less severe tundra fires, where fire stays on the surface, some plants will recover the following spring (Innes 2013). Typically, tundra fires tend to be of the latter type: fast-moving surface fires that do not disturb the underlying, moist organic soils. Most fires in tundra communities are less than 120 acres, with greater than 250,000-acre wildland fires rarely occurring (Viereck and Schandelmeier 1980).

The frequency and severity of wildland fire is projected to increase due to climate change. Projected climate change in the Refuge estimates temperatures will rise 1 degree Fahrenheit every decade and precipitation will increase 40 percent by 2080 (USFWS 2015). Warmer temperatures are expected to lead to changes in vegetation, a longer snow-free season, and loss of ice and permafrost. This, in turn, is likely to lead to longer fire seasons and increased fire frequency, severity, and area burned (Innes 2013).

While the affected environment for wildland fire is relevant for discussion, it is a resource that would not be altered by the proposed action alternatives. As such, this resource is not carried forward for an analysis of impacts.

3.3.3 Fish and Aquatic Species

Affected Environment

Fish Habitat

There are three primary aquatic habitats available to marine, anadromous, and freshwater species in and next to the program area: the lagoon and nearshore brackish waters of the Beaufort Sea; the rivers, streams, and springs emanating from the Brooks Range or Arctic Coastal Plain (ACP) tundra; and lakes or ponds that are concentrated mostly near the Beaufort Sea coast. The quantity and distribution of these habitats throughout the program area are summarized in **Table 3.3.3-1** and **Maps 3-12, Fish**

Table 3.3.3-1
Fish Habitat in the Program Area and Surrounding Area

Freshwater Streams	Total Anadromous Fish Habitat by Basin (miles) [a]	Anadromous Fish Habitat in the Program Area (miles) [a]	Streams in the Program Area (miles)[b]
Aichilik River	51	1	–
Akutoktak River	13	13	18
Angun River	8	8	33
Canning River	175[c]	46	41
Carter Creek	13	13	22
Hulahula River	73	27	27
Jago River	35	27	37
Katakturik River	20	20	22
Kimikpaurauk River	4	4	5
Kogotpak River	12	12	20
Marsh Creek	1	1	20
Nataroarok Creek	11	8	21
Nularvik River	3	3	3
Okpilak River	43	31	33
Sikrelurak River	11	11	21
Siksik River	5	5	7
Staines River	18	18	18
Tamayariak River	26	26	29
West Canning River	15	15	15
Unnamed Stream Total	47	26	–
Total Streams	**587**	**316**	**392**
Other Waters	**Miles**	**Acres**	
Total Lake Area[b]	–	23,100	
Unfrozen Lake Area[d]	–	6,400	
Coastline[e]	593	–	

Notes:
[a] Johnson and Blossom 2017. Data do not exist to quantify overwintering habitat by stream; the locations of overwintering habitat are depicted in **Map 3-12**, Fish Habitat and Distribution in the Program Area.
[b] USGS 2018. Data may conflict with Johnson and Blossom 2017: some streams may show fewer miles of stream than anadromous waters within the stream. These are the best available data for stream miles and anadromous fish habitat miles.
[c] Includes Marsh Fork Canning River
[d] NSSI 2018. Dataset indicates the presence of liquid water, but not depth of water. Thus, this data set overestimates potential fish overwintering habitat (unfrozen water may be range from a few inches to >7 feet), though it is the best available information for this topic. Numbers are surface area of lakes with any portion unfrozen.
[e] NOAA 2018

Habitat and Distribution and 3-13, Essential Fish Habitat in **Appendix A**. As described in **Section 3.2.10**, Water Resources, freshwater habitat is limited in the program area; especially during the winter, when aquatic habitat is reduced to approximately 5 percent of that available during summer. This reduction in habitat results in fewer freshwater and anadromous fish species in the program area, relative to other parts of the ACP along the Beaufort and Chukchi Seas (USFWS 2015) (**Map 3-12, Fish Habitat and Distribution** in **Appendix A**).

<u>Lagoons and Nearshore Brackish Waters</u>

The nearshore brackish and marine waters within the boundary of the Arctic Refuge, included the program area, are composed of a mix of open coastline, bays, and lagoons bounded on the north by barrier islands. During summer, these waters become brackish due to freshwater input from rivers

along the ACP (Dunton et al. 2006; USFWS 2015). Many of the inside barrier island lagoons are shallow and experience reduced currents and a small tidal flux of less than or equal to 1 foot, resulting in waters that are warmer and fresher than those outside the barrier islands.

Summertime mixing of marine waters with freshwaters produces conditions favorable to many marine and anadromous fishes,[12] as well as invertebrates (USFWS 2015); however, these brackish lagoon waters freeze earlier than the more saline coastal waters, resulting in hypersaline waters that are colder than offshore marine waters (USFWS 2015). During this period, there is little or no habitat available for fish. There are 16 bays and lagoons along the program area coastline, representing 593 miles of coastline and nearshore aquatic habitat potentially home to aquatic species (**Map 3-12, Fish Habitat and Distribution** in **Appendix A**).

<u>Rivers, Streams, and Springs</u>

The program area is underlain by continuous permafrost, which limits infiltration of surface water, resulting in a high ratio of stored water at the surface, rather than in the ground (USFWS 2015). Data on these water resources are limited, with few datasets going back more than 5 years.

All flowing surface waters in the program area drain to the Beaufort Sea. There are at least 10 major rivers and many smaller streams in the program area, though most flow only during summer, because of snowmelt, rainfall, perennial springs, and, in some cases, glacier melt (McCart 1980; Lyons and Trawicki 1994; Rabus and Echelmeyer 1998; Kane et al. 2013; USFWS 2015) (**Map 3-12, Fish Habitat and Distribution** in **Appendix A**). During winter, stream flow ceases due to freezing. The exception to this rule is in areas with perennial spring flow, which offer the only available overwintering habitat outside of summer (Kane et al. 2013; USFWS 2015) (**Map 3-12, Fish Habitat and Distribution** in **Appendix A**). Though there are 392 miles of streams in the program area, only 5 percent (roughly 20 miles) are habitable in winter (**Table 3.3.3-1**).

<u>Lakes</u>

A large portion of the program area is classified as wetlands, but lakes constitute very little of the total surface area of water for the region. Lake density from the Staines and Canning Rivers to the Aichilik River, which mark the western and eastern bounds of the program area, is lower than the ACP west of the Arctic Refuge (White et al. 2008; Arp and Jones 2009; USFWS 2015). The central portion of the program area in particular has very few lakes. Most program area lakes are near the delta areas of the Canning, Sadlerochit, and Jago Rivers (**Map 3-12, Fish Habitat and Distribution** in **Appendix A**) (USFWS 2015).

These lakes vary in surface area from less than 1 acre to approximately 1,500 acres, though most are less than 12 acres (USFWS 2015). Most are shallow and freeze solid during winter (Lyons and Trawicki et al. 1994). Only a fraction of the program area lakes have even a small volume of unfrozen water in winter because they are shallow (less than 7 feet) and freeze to the substrate (USFWS 2015). The lakes with remaining liquid water at the end of winter (generally deeper than 7 feet) occur mostly in the Canning River delta. Thus, fish overwintering habitat is extremely limited in area lakes. The total lake

[12] Fish species that inhabit the ocean mostly but return to inland waters to spawn.

surface area is 23,100 acres, with only 6,400 acres available as potentially deep, overwintering water (**Table 3.3.3-1**; overwintering acres are likely overestimated, as described in the table).

Fish Species

There are approximately 17 to 21 species of fish that use the program area regularly on a seasonal basis (**Table 3.3.3-2**); however, only the Dolly Varden, ninespine stickleback, and arctic grayling overwinter in freshwater habitats in the program area (**Table I-1** in **Appendix I,** Fish and Aquatic Species). Some species are described as overwintering in other parts of the Arctic Refuge (USFWS 2015), but they have not been confirmed in studies in the program area (USFWS 2015); thus, a range of likely species is presented in this EIS, based on the best available information. It is also likely that additional marine species, which are not listed in **Table 3.3.3-2**, may use waters north of the program area (USFWS 2015; BLM 2012).

Round whitefish and burbot are present in the Canning River at the western boundary but not elsewhere in the program area (Fruge and Palmer 1994; USFWS 2015). Dolly Varden are present in three resident freshwater populations—a resident dwarf form, a lake and spring form, and residual dwarf males of otherwise anadromous populations that stay in freshwater—and several anadromous populations (McCart and Craig 1973; USFWS 2015).

Arctic grayling occur in some lakes and also in rivers with perennial springs (Fruge and Palmer 1994; USFWS 2015). Most of the anadromous species described in **Table 3.3.3-2** use the nearshore marine area for migration or rearing; only Dolly Varden and ninespine stickleback are known to migrate into freshwater habitats in the program area. Various marine species also use the nearshore marine area, but only four are present in large numbers next to the program area (USFWS 2015): fourhorn sculpin, arctic flounder, saffron cod, and arctic cod.

Additional information on the life history attributes for fish of the program area are provided in **Appendix I,** Fish and Aquatic Species. This information provides context for understanding how potential future project activities may affect various life history stages for the species described. For example, species that take longer to reach maturity may be susceptible to environmental or habitat changes, depending on the location, timing, and duration of specific industrial related activities. Examples are the arctic cisco, other whitefish species that spawn infrequently, such as smelt and salmon, or those that use program area waters seasonally, which is most species.

Aquatic Invertebrates

Though data for aquatic invertebrates in the program area are limited, it is well understood that invertebrates provide the bulk of food resources for both fish and bird communities of the ACP (Howard et al. 2000). The most productive waters for invertebrates are in coastal marine environments, where benthic and pelagic organisms are plentiful and diverse. The distribution and density of invertebrates are dependent on the types and quantities of habitats including sediment and vegetation types (Dunton and Schonberg 2000). In freshwater habitats, benthic invertebrates and zooplankton are most prevalent, with the former dominating food sources for fish (Howard et al. 2000). Terrestrial insects likely contribute to freshwater invertebrate food resources for fish. For a more complete understanding of aquatic invertebrate communities in the Program Area and the ACP, refer to *The Natural History of an Arctic Oil Field* (Truett and Johnson 2000).

Table 3.3.3-2
Fish Species that may use the Program Area

FAMILY Common Name	Scientific Name	Freshwater	Anadromous	Marine
COTTIDAE: Sculpins				
Fourhorn Sculpin	*Myoxocephalus quadricornis*			+
Slimy Sculpin	*Cottus cognatus*	+		
GADIDAAE: Cods				
Arctic Cod	*Boreogadus saida*			+*
Burbot	*Lota lota*	+		
Saffron Cod	*Eleginus gracilis*			+*
GASTEROSTEIDAE: Sticklebacks				
Ninespine Stickleback	*Pungitius pungitus*	+	+ brackish	
OSMERIDAE: Smelts				
Rainbow Smelt	*Osmerus mordax*		+	
PLEURONECTIDAE				
Arctic Flounder	*Liopsetta glacialis*			+
SALMONIDAE: Salmonids				
Arctic Char	*Salvelinus alpinus*	+		
Arctic Cisco	*Coregonus autumnalis*		+	
Arctic Grayling	*Thymallus arcticus*	+		
Broad Whitefish	*Coregonus nasus*	+	+	
Chinook Salmon	*Oncorhynchus tshawytscha*		+*	
Chum Salmon	*Oncorhynchus keta*		+*	
Dolly Varden	*Salvelinus malma*	+	+	
Humpback Whitefish	*Coregonus pidschian*	+	+	
Lake Trout	*Salvelinus namaycush*	+		
Least Cisco	*Coregonus sardinella*	+	+	
Pink Salmon	*Oncorhynchus gorbuscha*		+*	
Round Whitefish	*Prosopium cylindraceum*	+		
Sheefish	*Stenodus leucichthys*	+	+	

Highlighted bars indicate species that may be extremely rare or uncomfirmed as present in Program Area waters. * Indicate species with designated Essential Fish Habitat (EFH) in the program area.

Essential Fish Habitat

The 1996 Sustainable Fisheries Act enacted additional management measures to protect commercially harvested fish species from overfishing. Measures were added to the Magnuson-Stevens Fishery Conservation and Management Act Reauthorization (16 USC. 1801–1882), including one to describe, identify, and minimize adverse effects on Essential Fish Hbitat (EFH). Pacific salmon EFH in the program area includes both marine water and freshwater. Marine EFH for salmon extends 200 nautical miles from the coast, though recent data indicate that EFH for these species on the ACP could be refined to just freshwater habitats (Echave et al. 2012). Freshwater EFH consists of the lower reaches of some larger rivers (**Map 3-13, Essential Fish Habitat** in **Appendix A**). Because there is no available spawning habitat for these species, EFH does not extend to the upstream reaches of these rivers. Arctic cod and saffron cod EFHs include the coastal lagoon and marine waters next to the program area, but they may also extend into the lower reaches of larger rivers during summer. Additional relevant information on EFH for the Arctic, including the Beaufort Sea coastline, can be found in the NPR-A IAP (BLM 2012).

Direct and Indirect Impacts

Potential direct and indirect impacts to fish and aquatic species were evaluated for all areas available for development under each alternative as specified by land use stipulations described in **Chapter 2,** Alternatives. As a proxy for a geographically explicit project footprint, potential impacts to fish and fish habitat were described by types of available fish habitat, scarcity of those habitats in the program area, and importance of those habitats to aquatic species.

Alternative A

Alternative A (No Action Alternative) would not include the direction under the Tax Cuts and Jobs Act of 2017 to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain within the Arctic Refuge. Therefore, oil and gas leases in the Program Area would not occur and current management actions would be maintained. Resource trends would continue as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015).

Impacts Common to All Action Alternatives

Project activities that could affect fish and fish habitat would occur under all action alternatives, though their locations could vary. Potential effects to aquatic species and habitats are summarized here; locations that would incur more or fewer impacts are described by alternative in the following sections.

<u>Habitat Loss or Alteration</u>

DIRECT HABITAT LOSS OR ALTERATION

Project activities with the potential to impact fish and aquatic species include the construction and operation of new gravel roads, gravel pads, airstrips, pipelines, culverts, bridges and barge landings or docks, and gravel mining.

Fill for project infrastructure would directly and permanently remove aquatic habitat within the fill footprint. Gravel fill would likely not be placed in waterbodies due to practicability; however, fill placed near waterbodies could alter aquatic habitats and indirectly impact fish as described below in Indirect Habitat Alteration. Bridge piers could be located in waterbodies or floodplains. A marine barge landing or dock could remove marine habitat. Direct aquatic habitat loss would be adverse, long term, and occur in the fill footprint.

Culverts could directly alter aquatic habitats by replacing substrates, banks, or both with metal pipe. This would adversely affect the habitat in the long term by removing the capacity of the fill footprint to contribute nutrients or organic matter to the waterbody.

Buried pipelines (e.g. the seawater treatment plant [STP] pipe) would alter marine sediments in the fill footprint due to trenching to bury the pipe. This would adversely affect the habitat in the short term by removing invertebrate food sources and potential algal cover in the trench footprint until the invertebrate and algal resources regenerate.

Because gravel is often most abundant in waterbodies, gravel mining may occur in waterbodies and floodplains, which would alter aquatic habitats. Existing habitats would be adversely affected in the long term by the removal of substrate and the capacity of the mining footprint to contribute nutrients or organic matter to the waterbody. Water quality would also be degraded in the short term due to

increased turbidity, which could lead to changes in dissolved oxygen or other water quality changes (see **Section 3.2.10**, Water Resources). Water depth would increase in the long term and could create new deep freshwater habitat for fish, as has been observed in other North Slope gravel mines (BLM 2012). Because deep habitats are limited in the Program Area, this could result in beneficial long-term effects for fish by creating new overwintering habitat.

INDIRECT HABITAT ALTERATION: DUST AND GRAVEL SPRAY

Project activities that could cause dust and gravel spray effects include construction and operation of new gravel roads and gravel pads, and vehicle traffic on gravel infrastructure.

Dust and gravel spray would be generated during gravel placement, gravel compaction, vehicle traffic on gravel roads and pads. Road dust accumulation is greatest within 35 feet of roads, but deposition may occur over a broader area. Roughly 95 percent of dust settles within 328 feet from the road surface (Myers-Smith et al. 2006; Walker and Everett 1987). Dust could increase turbidity in waterbodies directly adjacent to roads and construction areas as well as increase sediment and gravel inputs to existing substrates. This would have a long term adverse effect on aquatic habitats and species by decreasing habitat quality.

INDIRECT HABITAT ALTERATION: FLOW ALTERATION AND FISH PASSAGE

Project activities that could cause effects to flow alteration and fish passage include construction of ice roads, snow management activities, use of rolligons or other off-road vehicles for seismic surveys, maintenance, etc., and the placement of bridge piers or piles in waterbodies.

Flow alteration can result from obstructions in the natural flow path either by infrastructure or by compacted ice. Compacted ice over and surrounding waterbodies can delay ice melt and temporarily alter aquatic habitats. Compacted ice can change natural drainage patterns or cause water impoundments during spring breakup. Delayed melt of ice roads or pads can also temporarily block fish passage, which can impede Arctic fish attempting to migrate from overwintering areas to feeding habitat during the early part of the open-water season. As discussed in BLM (2012), many fish move upstream during break-up to access productive feeding habitat or to reach locations only accessible during spring flooding. Energy reserves in spring are typically low for most fish and additional stress or delayed access to feeding habitats could have adverse impacts. A barrier to movement could alter migration patterns to lower quality feeding habitat and increase energetic demands, which could compromise survival. Ice compaction would temporary alter aquatic habitats near project ice infrastructure or near where off-road activities would occur. This could have longer-term adverse effects on fish if their migration is annually delayed.

Bridge piers or piles could also alter flow due to ice blockage during spring breakup. Effects would be the same as those described above for flow alteration due to ice compaction.

INDIRECT HABITAT ALTERATION: WATER QUANTITY

Project activities that could cause effects to water quantity include water withdrawal from lakes or streams for ice roads, water supply, dust suppression, and other uses.

Water withdrawal from lakes can affect the amount of habitat available to overwintering fish, summer habitat accessibility, and habitat characteristics. Removal or compaction of snow can also increase the

depth of freezing on lakes. As a result, the water quantity available in a lake during the winter months can be greatly reduced.

Because unfrozen freshwater in winter is scarce in the program area, any withdrawal from these areas would cause the largest adverse effects to fish. These springs and deep lakes are sensitive areas, in part because there are so few of them that they limit the distribution of fish the program area.

INDIRECT HABITAT ALTERATION: WATER QUALITY

Project activities that could cause effects to water quality include:

- Water withdrawal from lakes or streams for ice roads, water supply, dust suppression, and other uses
- STP discharge to marine waters
- General construction activities in or near waterbodies
- Vehicle traffic on gravel infrastructure
- Gravel mining

Water withdrawal from lakes in the winter could temporarily alter lake-water chemistry (until spring breakup and recharge) by depleting oxygen and changing pH and conductivity. Reducing water quantity in a lake during the winter months can increase the salinity of the water beneath the ice.

Construction or gravel mining activities that disturb soils can increase sediment runoff and turbidity in streams. This would have a short term (during construction or mining) adverse effect on aquatic habitats and species around or immediately downstream from soil disturbing activities. Fugitive dust from vehicle traffic could also increase local turbidity in streams around gravel infrastructure. Dust effects on aquatic habitats and species would be long term and adverse.

Discharge of brine to the marine area from the STP could further increase salinity, particularly in the winter when freshwater may be frozen. Effects would be particularly pronounced if the discharge was located in the brackish lagoon waters that are hypersaline in winter.

<u>Disturbance or Displacement</u>

NOISE AND HUMAN ACTIVITY

Project activities that could cause effects related to noise and human activity include:

- Seismic surveys- use of vibroseis to image the subsurface
- Gravel mining (dredging or explosives)
- Pile driving for bridges or VSMs

Seismic surveys generate increased sound pressures in waterbodies. The high-intensity acoustic energy produced by seismic surveys can lead to damaged auditory sensory hair cells in fish, reducing their ability to hear (McCauley et al. 2003; Popper 2003; Smith et al. 2004). Underwater shock waves can also cause injury to the swim bladder and other organs and tissue, which could injure or kill fish. Increased sound pressures in unfrozen springs in winter could cause stress in fish because they would not have alternate habitats into which they could move to avoid effects. Thus, seismic surveys could disturb, injure, or kill

fish in unfrozen waterbodies (springs) in the winter. Vibroseis rigs operating on the ice overhead can create sound pressures great enough approximately 33 feet from the source to cause avoidance behavior (Greene 2000 and Nyland 2002 as cited in BLM 2012). Effects are further detailed in BLM (2012).

Noise generated by vehicles and machinery could have localized impacts on fish, such as stress-induced fleeing related to loud noises. The noise would be greatest during the construction but would occur to a lesser degree throughout the program area. Because most construction activities would occur in the winter when waterbodies would have ice cover, noise effects to fish would be reduced during that time.

<u>Injury or Mortality</u>

NOISE

Project activities that could cause effects related to fish and aquatic species from noise include:

- Seismic surveys- use of vibroseis to image the subsurface
- Gravel mining (dredging or explosives)
- Pile driving for bridges or VSMs

As described above in *Noise and Human Activity*, noise can disturb fish, and at higher decibels or in greater intensity, it can injure or kill fish. Restricting seismic surveys to winter when waterbodies (except springs) are frozen and avoiding areas around springs would minimize effects to fish.

Pile driving can also create sound levels that affect fish. Assuming that piles would be installed in winter, if the bridge or VSM sites froze to the bottom, the ice would attenuate the sound, and the potential impact to fish in adjacent overwintering habitats (if they exist) would be negligible.

ENTRAINMENT

Project activities that could cause effects related to entrainment include gravel mining and water withdrawal from lakes or streams, or from marine waters (Salinity Treatment Plant).

Though injury or mortality of fish from entrainment or impingement at water intake could occur, the effect would be minimized by ROPs that ensure that intakes be screened. As is described in BLM (2012), it is unlikely that fish would be entrained in the water intake.

CONTAMINANTS

Project activities that could cause effect related to contaminants include potential spills from storage, use, and transport of waste and hazardous materials, and potential oil spills from wells, pipelines, or other infrastructure.

As described in detail in BLM (2012), spills can adversely affect aquatic habitats and species by exposing them to contaminants. Spills can injure or kill fish and effects can be long or short lived depending on the type, size, duration, and season of the spill. See **Section 3.2.11**, Solid and Hazardous Waste for more discussion of spills.

Alternative B

Under Alternative B, select streams described in **Chapter 2**, Alternatives, would have 0.5- to 1-mile setbacks for surface development, though bridges, roads, and pipelines could still occur in the setbacks. Some streams would have no setbacks, and fish-bearing streams would have a 500-foot setback. Most of the coastal areas would not have setbacks. Thus, effects to unprotected streams and coastal areas and the species that use them would be most pronounced under this alternative, and the types of impacts would be the same as those described under *Impacts Common to All Action Alternatives*. Overwintering habitat (springs) would be unprotected from both surface development (beyond the 500-foot setback for fish-bearing waters) and from water or ice withdrawal, which could affect the long-term survival and distribution of freshwater fish in the program area. Alternative B would also have the most adverse effects to EFH since coastal areas and some anadromous streams would not be protected and could be developed.

Alternative C

Under Alternative C, the same select streams as Alternative B would have 0.5- to 1-mile setbacks for surface development. Some streams would have no setbacks, fish-bearing streams would have a 500-foot setback. There would be a 1 mile no surface development setback from the coast, and no development would be allowed in the coastal waters, lagoons, and barrier islands. Additionally, the southeast part of the program area would not be offered for lease. Some of the critical springs that are vital overwintering habitat for fish would not be protected (beyond the 500-foot setback for fish-bearing waters) from surface development or from water or ice withdrawal, and thus long-term survival and distribution of freshwater fish in the program area could be affected.

Alternative D

Under Alternative D, all streams would have a 0.5- to 4-mile setback for surface development. Permanent facilities would be prohibited within 0.5 miles of the ordinary high water line of all waterbodies in the Canning River Delta, which would protect the majority of lakes in the program area. Additional setbacks would be provided for springs and aufeis areas, which would reduce effects to aquatic species and habitats as described under *Impacts Common to All Action Alternatives*. There would be a 2 mile no surface development setback from the coast, and no development would be allowed in coastal waters, lagoons, and barrier islands. Withdrawal of unfrozen water from lakes may be permitted. Gravel mining would not occur in the active floodplain or channel of the Canning, Sadlerochit, Hulahula, and Aichilik rivers.

Cumulative Impacts

Past and present actions in the program area have been limited, and thus have had limited effects on aquatic species and habitats. Infrastructure developed for the community of Kaktovik may have indirectly affected or be affecting aquatic habitats and species by contributing dust and gravel spray to streams, altering habitat by withdrawing water, and disturbing or displacing fish due to noise. All action alternatives would incrementally contribute to cumulative impacts on fish and aquatic resources.As discussed in BLM (2018) climate change is impacting many variables that affect aquatic species and habitats including precipitation, timing of ice formation, permafrost degradation and changes to hydrologic functions, and water quality (temperature and dissolved oxygen). Climate change will continue to occur in the program area, and future projects within the program area would produce GHG that could incrementally contribute to climate change and its effects. Increasing temperature is

expected to change climate patterns and lengthen the ice-free season, degrade permafrost, and increase evaporation, processes that contribute to surface water hydrology and may reduce (Laske et al. 2016) or increase (Stueffer et al. 2017) surface water connectivity. Reductions in connectivity (e.g., drying of channels or ponds) may in turn reduce colonization opportunities for fish by limiting dispersal pathways and movement between habitats (Laske et al. 2016). This could change local species assemblages or species richness.

3.3.4 Birds

Affected Environment

As of 2015, 156 bird species have been recorded on the Arctic Refuge Coastal Plain (ARCP) (an area inclusive of the program area) and in adjacent marine waters (**Table H-1** in **Appendix H**). Seventy, or 45 percent, of those species are confirmed breeders or permanent residents, or both; 11 are possible breeders, 40 have been recorded staging or migrating in the area (some also breed there), and 64 are visitors only.

The bird species of the ARCP and adjacent marine waters is dominated by species groups with smaller body sizes, with shorebirds being the most abundant group, followed by land birds (Pearce et al. 2018). Waterfowl, loons, grebes, and cranes also use the ARCP in large numbers. The other bird groups present in lower numbers are gulls, jaegers, and terns, raptors and owls, and seabirds. Many of the 156 species recorded are uncommon or rare; only 57 species are known to occur regularly in substantial numbers on the ARCP and are classified as fairly common, common, or abundant (Pearce et al. 2018; **Table H-1** in **Appendix H**).

The ARCP is large, encompassing roughly 2 million acres, and represents a substantial portion of the Beaufort Sea coastline in Alaska. Accordingly, it also supports a large number of birds during the important nesting, rearing, and migration staging periods. For these reasons, the ARCP and adjacent marine waters are recognized as important bird areas (IBAs) by the American Bird Conservancy, Audubon, and Birdlife International. Because the ARCP completely encompasses it, the program area is considered part of the IBA. Prior studies (summarized in USFWS 2015a) have demonstrated that at least several hundred thousand breeding and nonbreeding birds use the ARCP and program area during the short Arctic summer.

Although there are historical survey data for the ARCP, as described in USFWS and BLM (2018), most of the current information on bird abundance and distribution for the program area was collected for only 1 or 2 years, covers only a small portion of the program area, or was collected at low survey intensity. The program area contains far fewer water bodies, compared with sites farther west, such as Prudhoe Bay and the NPR-A. Because of this, many water birds and shorebirds are patchily distributed, which increases the difficulty in determining accurate abundance levels based on a small numbers of surveys.

A few bird species have been relatively well studied on the ARCP, such as golden eagles and snow geese (summarized in USFWS 2015a), but detailed distribution and abundance data are lacking for many species. Information about the various bird species and species groups found in the program area is summarized below.

Special Status Species

Of the 156 species known to occur in the program area, 10 are recognized as BLM Sensitive Species (BLM 2018), 11 are USFWS birds of conservation concern (USFWS 2008), and 44 are recognized as at-risk species by the Alaska Department of Fish and Game (ADFG) (**Table H-1** in **Appendix H**). At-risk species are those with a small population size or range, a declining population, or a population facing documented threats. At-risk rankings also incorporated the conservation concern listings prepared by other agencies and specialist groups focused on the conservation of Alaska birds (ADFG 2015).

Steller's eiders, the smallest of the four eider species, are tundra-nesting sea ducks. Their primary breeding range is in eastern Siberia, where they nest in wet tundra near freshwater ponds with and without emergents[13] (Fredrickson 2001; Saffine 2013, 2015; Graf 2016). The Alaska-breeding Steller's eider, belonging to a larger Pacific population, was listed under the Endangered Species Act (ESA) as a threatened species in 1997 (62 FR 31748–31757).

Critical habitat was designated for Steller's eiders in western Alaska, but no critical habitat was designated on the North Slope. Although the nesting distribution on the North Slope once extended eastward to Demarcation Bay, most Steller's eiders nest in the Utqiagvik area (Quakenbush et al. 2002). Although Steller's eiders could occur in the program area, it would be unusual. The species is considered to be a rare visitor only in the program area (**Table H-1** in **Appendix H**) and is not expected to nest that far east on the North Slope Coastal Plain.

The spectacled eider is a medium-sized eider, breeding on tundra in the Arctic and western Alaska and eastern Siberia and spending the rest of the year at sea, after young are can fly (Petersen et al. 2000). The spectacled eider was listed as threatened in 1993, after a severe decline of the species on the Yukon-Kuskokwim Delta (58 FR 27474–27480). Critical habitat was designated in 2001 in Ledyard Bay in the Chukchi Sea and in other areas of western Alaska (66 FR 9146–9185). No critical habitat occurs in the program area.

The spectacled eider breeds on the Arctic coast from Point Lay and Utqiagvik to the Sagavanirktok River (USFWS 1996). The program area is in a low density region for pre-nesting spectacled eiders. ACP aerial surveys in 2013 to 2016 recorded low densities of pre-nesting spectacled eiders in those portions of the program area that were surveyed (0 to 0.07 birds/km^2) (**Map 3-14,** Spectacled Eider in **Appendix A**). The distribution of nesting is unknown in the program area because extensive surveys have not been undertaken. Low numbers of spectacled eiders are expected to occur in the program area during the pre-nesting period, where suitable habitat is available.

Water Birds

As treated in this EIS, water birds on the ARCP are waterfowl, loons, grebes, and cranes. Thirty-seven species of water birds have been observed on the ARCP. Of these, 23 species are confirmed breeders or migrants (or both), and 14 are visitors (**Table H-1** in **Appendix H**). The group of 23 breeders/migrants includes 13 species of ducks, 4 geese, 3 loons, 2 swans, and 1 crane. Of these 23 species, the spectacled eider is an ESA threatened species (USFWS and NMFS 2014), 3 are BLM Sensitive species (BLM 2018), 2 are USFWS birds of conservation concern (USFWS 2008), and 4 are

[13] A water plant whose leaves and flowers appear above the surface.

ADFG at-risk species (ADFG 2015) (**Table H-1** in **Appendix H**). Waterbirds, especially ducks and geese, are an important subsistence resource for local residents in Kaktovik (summarized in USFWS 2015a).

Seventeen water bird species are fairly common, common, or abundant in the program area as either breeders or migrants: greater white-fronted goose, snow goose, brant, cackling goose, tundra swan, American wigeon, northern pintail, greater scaup, king eider, common eider, surf scoter, white-winged scoter, long-tailed duck, red-breasted merganser, red-throated loon, Pacific loon, and yellow-billed loon (Pearce et al. 2018).

Breeding water birds generally arrive on the coastal plain of the North Slope in late May and June and begin nesting from late May through July (Johnson and Herter 1989). In addition to water body shorelines and islands, most water birds use a variety of wet and moist tundra habitats for nesting (but see *Common Eider* below).

The USFWS has conducted surveys of nesting water birds on the coastal plain of the North Slope since 1986 (Stehn et al. 2013); however, only one-third of the program area has been surveyed, providing an index of species breeding there but with little power to detect trends in populations of breeding birds (Pearce et al. 2018). After hatching in July and August, most water birds occupy lakes and ponds to rear their young, although geese and cranes graze in tundra wetlands. In the late summer, post-breeding and molting (temporarily flightless) water birds use coastal lagoons behind the barrier islands. Water birds continue to forage in the lagoons in the fall as they stage for the southward migration.

<u>Common Eider</u>

Common eiders are an important subsistence resource for North Slope residents. The USFWS conducts annual aerial surveys to estimate the number, distribution, and population trend of breeding common eiders in coastal habitats on the North Slope, including Arctic Refuge lands (summarized in USFWS 2015a) (**Map 3-15**, Common Eider in **Appendix A**). Common eiders have been increasing in abundance on their barrier island breeding grounds in the Arctic Refuge since 1976, when only 14 nests were found. In a 2015 ground-based survey conducted across most Arctic Refuge barrier islands, over 800 common eider nests were found (Christopher Latty, USFWS, unpublished data).

<u>Waterbird Use of Coastal Lagoons</u>

A large number of water birds in the post-breeding period use the coastal lagoons behind the common barrier islands along the program area's coast (**Map 3-16**, Waterbirds in **Appendix A**). In aerial surveys of nearshore waters and barrier islands conducted during the early post-breeding period (early July 1999–2009), 17 water bird species were recorded regularly (Dau and Bollinger 2009).

The most abundant species recorded was surf scoter (average of 2,173 individuals), followed by long-tailed duck (average of 819 individuals), common eider (average of 593 individuals), and glaucous gull (average of 553 individuals). In aerial surveys conducted later in the season (late July and early August 2002 and 2003), thousands more long-tailed ducks were observed, with over 28,000 birds recorded in one year (Lysne et al. 2004). These data suggest that long-tailed ducks from a larger geographic area move to coastal lagoons in the Arctic Refuge in late summer and fall.

During those same aerial surveys conducted in 2002 and 2003, up to 20, 28, 29, 33, and 41 percent of the yellow-billed loons, red-throated loons, long-tailed ducks, scaup, and pacific loons, respectively, counted across the entire North Slope survey area were in the lagoons and nearshore areas along the Arctic Refuge coast.

<u>Snow Geese</u>

Up to 325,000 snow geese use the ARCP as a staging area for fall migration (USFWS and BLM 2018) (**Map 3-17**, Snow Geese in **Appendix A**). They come from nesting areas on Banks Island and elsewhere in the Canadian Arctic to graze in upland and coastal tundra habitats (Hupp et al. 2002). The breeding population on Banks Island more than doubled, from 200,000 in the early 1990s to 500,0000 in 2013 (Pacific Flyway Council 2013); the population breeding across the entire coastal plain of the North Slope has also increased dramatically in that time (Burgess et al. 2017; Hupp et al. 2017). In the last surveys of staging snow geese conducted in 2004, 189,636 individuals were recorded (USFWS 2015a). If trends in staging reflect population trends in breeding areas, the number of geese staging in the program area is likely higher. Snow geese depend on this staging period to build energy reserves for their southward migration (Brackney and Hupp 1993).

Shorebirds

Thirty-three shorebird species have been recorded on the ARCP, 21 of which are confirmed breeders or migrants (or both) and 12 are visitors (**Table H-1** in **Appendix H**). The group of 21 breeders/migrants includes 16 sandpiper species, 3 plovers, and 2 phalaropes. As a group, shorebirds are of increasing conservation concern. This is because many species have been undergoing population declines over the past several decades. Of the 21 breeding/migrant shorebird species, 4 are BLM sensitive species (BLM 2018), 4 are USFWS birds of conservation concern (USFWS 2008), and 9 are ADFG at-risk species (ADFG 2015) (**Table H-1** in **Appendix H**).

Seventeen shorebird species are fairly common, common, or abundant in the program area as either breeders or migrants: black-bellied plover, American golden-plover, semipalmated plover, upland sandpiper, whimbrel, ruddy turnstone, stilt sandpiper, sanderling, dunlin, Baird's sandpiper, buff-breasted sandpiper, pectoral sandpiper, semipalmated sandpiper, western sandpiper, long-billed dowitcher, red-neck phalarope, and red phalarope (Pearce et al. 2018).

Shorebirds arrive on the North Slope in mid-May through June. Most begin nesting in June, though a small number begin laying eggs in late May and into early July (Saalfeld and Lanctot 2015). Shorebirds use a wide range of aquatic, wet, and moist tundra habitats for nesting, often, but not always, near bodies of water. Brown et al. (2007) conducted surveys of breeding shorebirds in June 2002 and 2004; they recorded 14 shorebird species and estimated that 230,000 shorebirds (95 percent confidence interval of 104,000 to 363,000) occupied the program area during the breeding season.

Species richness and density typically were highest in coastal wetland and riparian habitats and near river deltas. Among wetland plots, densities were highest near the Canning River delta on the western edge of the program area. In a review of studies conducted across the entire North Slope, Johnson et al. (2007) determined that shorebirds were more abundant near the coast than farther inland and that species richness was highest to the west, in the NPR-A; however, several species were more common in the east, reflecting diversity in abundance within individual species across the coastal plain of the North Slope.

After hatching, most shorebirds use open tundra and shorelines to rear their young; as the young become flight capable, they begin to forage on the coast. In late July through September, shorebirds stage on ARCP river deltas for the fall migration to wintering areas in the Americas and Asia; most of the deltas are used by large numbers of foraging shorebirds, with the Jago River delta being one of the most heavily used areas (summarized in USFWS 2015a and Pearce et al. 2018). Most of the shorebirds foraging in the river deltas in late summer and fall are juveniles hatched earlier in the summer. The data from birds marked with radio transmitters indicate that individuals that migrate via the Central Flyway use multiple river deltas as they gradually migrate eastward across the ARCP.

Larids

Larids on the ARCP are gulls, jaegers, and terns. Sixteen larid species have been recorded on the ARCP, 9 of which are confirmed breeders or migrants (or both) and 7 are visitors (**Table H-1** in **Appendix H**). The 9 breeding/migrant species are pomarine jaeger, parasitic jaeger, long-tailed jaeger, ivory gull, Sabine's gull, Ross's gull, mew gull, glaucous gull, and arctic tern. None of these are BLM sensitive species (BLM 2018), 1 is a USFWS bird of conservation concern (USFWS 2008), and none are ADFG at-risk species (ADFG 2015) (**Table H-1** in **Appendix H**).

Larids arrive on the North Slope roughly at the same time as shorebirds, in mid-May through June (Johnson and Herter 1989). They breed across the ARCP in a range of habitats, including open tundra (primarily jaegers), shores and islands on tundra lakes, and on the barrier islands (primarily gulls and terns). During the breeding season, the smaller gulls and terns generally feed on aquatic invertebrates and small fish, whereas jaegers largely prey on small mammals, birds, and eggs.

The single larger gull species (glaucous gull) is omnivorous and also can prey on small birds and eggs. Local residents report that glaucous gull populations on the ARCP have been increasing, and there is some evidence of increases in gull populations in the Arctic generally (National Research Council 2003). These increases could be due to global changes in their populations or increased human development in the area (Weiser and Powell 2010). There are numerous accounts of glaucous gulls foraging in North Slope landfills. Distribution maps from aerial surveys indicate that gulls tend to concentrate in the vicinity of human development on the coastal plain of the North Slope, including Kaktovik on the Arctic Refuge (summarized in USFWS 2015a).

Raptors

As treated in this EIS, raptors on the ARCP include eagles, hawks, falcons, and owls. Thirteen raptor species have been recorded on the ARCP, 6 of which are confirmed breeders or migrants (or both) and 7 are visitors (**Table H-1** in **Appendix H**). The 6 breeding/migrant species are rough-legged hawk, golden eagle, gyrfalcon, peregrine falcon, snowy owl, and short-eared owl. None of these are BLM sensitive species or USFWS birds of conservation concern (BLM 2018; USFWS 2008), and 4 are ADFG at-risk species (ADFG 2015) (**Table H-1** in **Appendix H**). Golden eagles are protected under the Bald and Golden Eagle Protection Act. The arctic peregrine falcon subspecies, which breeds on the ARCP, was previously listed as endangered under the ESA, but it has been delisted (USFWS and NMFS 2014).

Golden eagles nest almost exclusively in cliff habitats and, in the program area, they nest primarily in the Brooks Range foothills, as cliff habitat is rare elsewhere on the ARCP. Breeding golden eagles return to Alaska, presumably including the Arctic Refuge, from late February to mid-April, with nonbreeders arriving later (summarized in Kochert et al. 2002).

In the Arctic Refuge, nesting begins from late March to early May (Young et al. 1995). Some snowy owls winter on Arctic breeding grounds, but most arrive on the North Slope during April and May, with most egg laying in mid-May (summarized in Holt et al. 2015). The remaining raptors arrive and begin nesting in May and early June (Johnson and Herter 1989).

Golden eagles are commonly observed on the ARCP in late June and early July, when calving and post-calving caribou herds are present; these are primarily subadult birds that are preying on or scavenging caribou calves (summarized in USFWS 2015a). In a 1983–1985 study, golden eagles were the main predators on caribou calves on the calving grounds (Whitten et al. 1992; Griffith et al. 2002). It also appears that birds from other regions in the state use northern Alaska, including the Brooks Range and ARCP; eagles that hatched in the Alaska Range were found in the Arctic Refuge during at least two subsequent summers (summarized in USFWS 2015a).

Surveys on the ARCP were conducted on the Canning, Hulahula, and Kongakut Rivers in the 1990s and early 2000s to monitor cliff-nesting raptors (summarized in USFWS 2015a). Raptors nesting on cliffs along these rivers are golden eagles, peregrine falcons, gyrfalcons, and rough-legged hawks. On the ARCP, cliff nest habitats occur primarily in river corridors; in the surveyed areas the overall abundance of nesting raptors generally was found to be low.

The two owl species, snowy owl and short-eared owl, that breed on the ARCP are variable in abundance among years. As in other regions on the North Slope, both species are substantially more common as breeders in years of high microtine (i.e., vole or lemming) rodent abundance (Johnson and Herter 1989).

Land Birds

As treated in this EIS, land birds on the ARCP include a diversity of species that are strongly dominated in abundance by passerines[14] and ptarmigans. Fifty land bird species have been recorded on the ARCP, but 32 of these are visitors; only 18 are confirmed breeders, permanent residents, or migrants (**Table H-1** in **Appendix H**); this includes 16 passerines and 2 ptarmigan species. None of the 18 breeding/migrant land bird species are BLM sensitive species or USFWS birds of conservation concern (BLM 2018; USFWS 2008), and 8 are ADFG at-risk species (ADFG 2015) (**Table H-1** in **Appendix H**).

Most land birds on the coastal plain of the North Slope are migrant species that arrive in mid-May through June and begin nesting shortly thereafter (Johnson and Herter 1989). The willow ptarmigan, rock ptarmigan, and common raven are year-round residents. By far the most abundant land bird species on the ARCP is Lapland longspur, which nests throughout the area in wet and moist tundra habitats. Other relatively common species on the ARCP are rock ptarmigan (found throughout the area), willow ptarmigan (more common inland), common raven (found throughout the area), eastern yellow wagtail (most common in riparian areas), common and hoary redpoll (found throughout the area), snow bunting (more common on the coast), savannah sparrow (more common inland), and American tree sparrow and white-crowned sparrow (more common inland) (Pearce et al. 2018).

[14] Perching birds

Seabirds

Seabirds occurring in marine waters next to the ARCP are fulmars, shearwaters, and alcids. Seven seabird species have been recorded in marine waters off the ARCP, but 5 of those species are visitors. Only the black guillemot occurs as a rare breeder on barrier islands and the thick-billed murre as a rare migrant (**Table H-1** in **Appendix H**). Of the 2 breeding/migrant seabird species, neither is a BLM sensitive species or USFWS bird of conservation concern (BLM 2018; USFWS 2008), and neither is an ADFG at-risk species (ADFG 2015) (**Table H-1** in **Appendix H**).

Direct and Indirect Impacts

Potential impacts of oil development on birds include four primary categories of effects: habitat loss and alteration, disturbance and displacement (including alteration of behavior), injury and mortality, and attraction of predators and scavengers (including both mammals and birds) to human activity or facilities. The season in which activities occur would either moderate or accentuate the effects on birds. Winter activities would affect few species and low numbers of year-round residents. Summer activities would affect breeding birds during the nesting, brood-rearing, molting, and fall migration-staging seasons, when many species are present in high numbers and population or reproductive consequences of impacts are greatest.

Although many activities (e.g., vehicle traffic) would occur during all phases (exploration, construction, drilling, and operations) of a development project, the potential intensity of impacts on birds differs among phases. Exploration activities occur during winter and would have little direct effect on birds; indirect effects would occur only through potential effects of ice roads and rolligon traffic to vegetation and terrain surfaces. Human-caused disturbance and displacement would peak during the construction phase, which involves the largest number of people, temporary construction camps, and the highest levels of vehicle, machinery, heavy-haul equipment, and aircraft traffic. Habitat loss also would peak during construction, including the building of ice roads to support gravel extraction, gravel hauling, gravel road and pad construction, bridge construction, and pipeline construction. Barging and in-field transport of CPF modules would occur early in construction and also affect birds through habitat loss and disturbance. The drilling phase of a development project would require less personnel and traffic than during construction, but still higher levels than during operations. Air traffic and vehicle traffic would peak during construction and drilling (personnel numbers peak during construction and materials transport during drilling). Traffic rates would be lower during operations.

Schedules of development projects in the program area are unknown, but foreseeable scenarios indicate extensive overlap of exploration, construction, drilling, and operation phases of potentially several different projects with different operators. In terms of impacts to birds, activities and area affected would increase until the limit of 2,000 acres of gravel footprint for facility construction is reached in years or perhaps decades after initial project construction; these activities would occur dispersed in different parts of the area available for lease over that period.

For most actions, impacts can only be described qualitatively either because resource and impact data are unavailable or because project details are uncertain or unknown at the time of this preliminary analysis. For most types of habitat impacts and for some types of behavioral disturbance, semi-quantitative estimates of areas affected are possible.

Direct effects on avian habitats would occur in in the footprint of gravel fill, whereas indirect effects on habitat would occur at varying distances, depending on the source. Fugitive dust, gravel spray, thermokarsting, and impoundments may affect soils and vegetation up to 328 feet away from roads and pads (see **Section 3.3.1**, Vegetation and Wetlands). Disturbance and displacement could occur over a larger area (see discussion, below). The USFWS uses 656 feet as the distance from oilfield infrastructure for which they calculate incidental take of nesting spectacled eiders (USFWS 2015), a distance that accounts for loss due to disturbance and displacement.

Using the schematic anchor-field footprint (one CPF and 6 radiating 8-mile access roads to 6 drill pads, including an STP pad and a 30-mile access road, totaling 750 acres), we calculated estimates of the area within 328 feet, for impacts of dust fallout, gravel spray, thermokarsting, and impoundments, and within 656 feet for impacts of disturbance and displacement. Using these standardized footprints and extrapolating to a 2,000-acre maximum gravel footprint, we estimated total acres indirectly affected by habitat alteration and by disturbance and displacement and compared these areas with areas available for lease under each action alternative.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the program area would be offered for future oil and gas lease sales following the ROD for this EIS. Alternative A would not include the direction under the Tax Cuts and Jobs Act of 2017 to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain within the Arctic Refuge. Under this alternative, current management actions would be maintained and resource trends would continue, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). No direct or indirect impacts to birds would occur under Alternative A.

Impacts Common to All Action Alternatives

The following actions and types of effects would be common to all action alternatives, but the avian resources affected (e.g., total area, specific habitats, bird species, and bird densities) would vary based on the location of facilities in each action alternative.

<u>Habitat Loss and Alteration</u>

Temporary alteration of habitat would occur from winter ice roads and pads. Ice road alignments are unavailable for calculating areas affected, but proposed use of ice roads is extensive under all action alternatives, including an annual ice road between the program area and the Prudhoe Bay/Deadhorse road system. Ice roads and pads can interfere with natural drainage of spring runoff and additional habitat alteration can occur through vegetation damage, including reduced live and dead cover due to crushed standing plant cover, stem and blade breakage, compaction, freezing, and physical damage (see **Section 3.3.1**, Vegetation and Wetlands). Although recovery of sedges, grasses, and forbs may occur in two to three growing seasons (Pullman et al. 2005), tussocks and woody shrubs often take longer to recover (Yokel et al. 2007). Vegetation damage is most severe and takes longer to recover in well-drained areas, including moist tundra and shrub habitats, which support lower densities of waterbirds. In contrast, aquatic and wet tundra habitats, which are favored by most waterbird species (Derksen et al. 1981; Johnson et al. 2003a, 2005, 2007), generally are damaged less by ice roads and recover more quickly (Guyer and Keating 2005; Pullman et al. 2005). Habitat alterations from ice roads are likely and their impacts will be short to long term in duration, depending on the types of vegetation affected and

whether routes and pad sites are re-used in multiple years. Habitat alteration from ice roads is expected to have minor impacts on birds and the extent would be limited to the immediate area covered by ice.

Drawdown of water source lakes could alter lake habitats by lowering water levels, which might impact birds nesting on shorelines or islands or reduce fish prey for loons. Although water withdrawals will be limited to permitted lakes and to permitted percentages of total lake volume to protect resident fish, water withdrawals possibly could cause lower lake levels and exceed natural recharge (see **Section 3.2.10**, Water Resources). Withdrawal of water from under ice could affect water chemistry and turbidity and possibly result in some fish mortality (see **Section 3.3.3**, Fish and Aquatic Species). Water-source lakes may include lakes used by yellow-billed loons for breeding. Drawdowns may cause fish mortality, and lack of fish would make such lakes unsuitable for breeding loons. Drawdowns could change shorelines, making shoreline and island nesting sites unsuitable for loons and for other waterbirds. The long-term loss of nesting lakes would have potential population consequences for yellow-billed loons.

Gravel would be mined during winter at several unidentified material sites and transported over gravel roads and/or ice roads. Rehabilitation would follow North Slope reclamation guidelines. The pits remaining from excavation would be used as water sources during drilling and operations, and possibly used by non-breeding and brood-rearing waterbirds. The habitat loss or alteration from gravel excavation would affect up to 320 acres of surface disturbance, the impact to birds would be long-term but minor and somewhat ameliorated by reclamation plans (i.e., terrestrial breeding habitats could be replaced by aquatic habitats, possibly with some rehabilitated island habitats that could be used by breeding birds).

Construction of gravel pads and roads would result in long-term direct loss of habitat and indirect alteration of habitat. Direct losses from gravel coverage (up to 2,000 acres allowable) would last as long as the oil projects are active, or until gravel is partially removed from retired roads and pads to restore some habitat features (estimated to be 85 years after the first lease sale before all facilities described in the RFD scenarios are abandoned and reclaimed). Indirect habitat modification would result from fugitive dust (i.e., dust shadow) and gravel spray, changes in drainage resulting in impoundments and vegetation desiccation, thermokarsting, and delayed melt of snow in snow drifts or berms created by snow removal. Fugitive dust would generally affect the largest area, extending as much as 328 feet from gravel roads (see **Section 3.3.1**, Vegetation and Wetlands; Walker and Everett 1987).

Using a drawing of a standardized anchor field (one CPF and 6 radiating 8-mile access roads to 6 drill pads, one STP pad and a 30-mile access road, totaling 750 acres), the area within 328 feet (for impacts of dust fallout, gravel spray, thermokarsting, and impoundments) was estimated to be about 5,630 acres. Actual area affected would depend entirely on the configuration of roads, but these numbers indicate that indirect impacts of gravel roads and pads would affect an additional area about 7 to 8 times larger than the gravel footprint. Minimization of effects on birds would be accomplished by using the shortest road routes, smallest pads, and placement of gravel in uplands and well-drained habitats composed of moist and shrub tundra. Habitat alteration caused by fugitive dust, thermokarsting, and water impoundments intensifies with time. As dust and gravel spray accumulate, vegetation is slowly affected, and thermokarsting deepens or spreads. Loss and alteration of habitat from direct effects of gravel deposition and indirect effects of dust, thermokarsting, and impoundments would be long-term and

occur over about 17,000 acres (2,000 acres total gravel footprint plus approximately 15,000 acres within 328 feet), or about 1 percent of the program area (1,592,300 acres).

Screeding for barge access would result in short-term (one season) habitat modification in the affected lagoon just prior to each barge arrival. It is anticipated that each CPF module would be shipped on 2 barges and that CPFs would be built at 10–15 year intervals and that up to three could be active at any one time. Screeding would modify the sea floor in shallow water. The area of screeding and redistribution would likely be lost in the short-term to benthic feeding birds and would create a sediment plume that could disrupt feeding by non-breeding, post-breeding, and staging birds. Although high numbers of birds use the lagoons, they are highly mobile and likely would be able move to adjacent similar areas if necessary. Long-tailed ducks made up 80 percent of the birds on surveys during late summer and fall in nearshore waters of the Beaufort Sea (Fischer et al. 2002). Other taxa included many of the taxa potentially breeding in the program area plus common eiders, and scoters. Potential habitat alteration in the area is expected to be brief, only occurring during screeding and vessel travel. Habitat alteration impacts from screeding are expected to be of short duration, and would occur in localized areas.

<u>Disturbance and Displacement</u>

Gravel transport and placement and pipeline construction would take place in winter from ice roads and, after initial construction, from existing gravel roads. Traffic and machinery related to winter construction could cause disturbance, behavioral alterations, and displacement to resident wintering birds. Although winter construction activity would involve more traffic and machinery than other phases, potentially resulting in higher levels of disturbance and displacement, only small numbers of birds of only a few species are resident during winter and none are breeding. Winter construction therefore would affect small numbers of non-breeding birds during the construction phase of each development project.

Construction activities during summer would occur on gravel roads and pads, which could cause short term behavioral changes or displacement of breeding birds. Summer construction activity would involve gravel grading and compacting, module and pipeline hookups, and facility construction (camp, operations center, CPF, etc.). Summer construction activities would have higher levels of machine, heavy equipment, and vehicle traffic, and more human activity than during drilling or operations, thus higher rates of disturbance-caused behaviors and displacement of birds. During drilling and operations, similar types of disturbance and displacement would continue and additional helicopter, boat, and human activity likely would occur associated with pipeline inspection and maintenance, surveying, cleanup and spill prevention and response activities (equipment deployment and maintenance, boom placement on waterways, etc.).

Human-caused disturbance could cause behavioral changes in birds, ranging from alert postures to flush or flight behaviors (Murphy and Anderson 1993; Johnson et al. 2003a; Livezey et al. 2016). At low levels, disturbance could increase concealment and incubation constancy, interfere with resting and feeding activities, and increase energetic costs. At higher levels, flight behaviors could affect reproduction through increased absences from nests and nest abandonment, thereby increasing the likelihood of predation leading to nest failure (Uher-Koch et al. 2015; Stien and Ims 2015), or disintegration of broods and chick predation. Human disturbance can lead to displacement of breeding birds (Johnson et al. 2003a), which may or may not affect reproduction. Studies of bird responses to human disturbance in

oilfields indicate that responses vary among species, by season and breeding status, by type of human disturbance, and by distance to the source of disturbance (Anderson et al. 1992; Murphy and Anderson 1993; Johnson et al. 2003a, 2008a). Displacement of some species of tundra nesting birds results in redistribution to adjacent similar habitats (Troy and Carpenter 1990; Johnson et al. 2003a).

As discussed previously, for assessment of potential effects of disturbance and displacement by road traffic, the area was calculated within 656 feet of roads, pads, and pipelines as a conservative estimate of the area affected by disturbance and displacement for all species of birds. This overestimates the area of disturbance for nesting shorebirds and passerines, which respond at very close distances (13 to 22 m; Livezey et al. 2016), but likely underestimates the area for more sensitive birds such as nesting tundra swans (≥500 m; Monda et al. 1994). Disturbance and displacement could affect nesting within 0.8 mi of active roads (Johnson et al. 2003a). Liebezeit et al. (2009) documented a decrease in nest survival of some species within 3.1 mi of oilfield facilities due to nest predators attracted to facilities. A review of literature on reported distances from various motorized and non-motorized human activities at which nesting birds initially respond and at which they take flight found all species studied reacted and flushed at mean distances less than or equal to 656 feet except for Falconiformes (falcons, hawks, and eagles), which reacted at greater distances to some disturbance types (Livezey et al. 2016). Fall migration-staging flocks, including shorebirds in river deltas, molting long-tailed ducks and other birds in lagoons, and snow geese in tundra habitats may also be subject to disturbance and displacement.

As for estimating habitat impacts, above, a drawing of a standardized anchor field was used to estimate the area within 656 feet for impacts of disturbance and displacement. The actual area affected would depend entirely on the configuration of roads, but with a standardized footprint of 750 acres, an additional 11,820 acres of tundra within 656 feet was calculated, an additional area about 15 to 16 times larger than the gravel footprint. With a 2,000-acre gravel footprint at peak development, disturbance and displacement of breeding birds in tundra habitats could occur over about 31,000 acres or about 2 percent of the program area (1,592,300 acres). Impacts of disturbance and displacement by summertime construction and operations activities would be long-term and may affect nesting success for some birds near facilities but are unlikely to affect population sizes or nesting densities of breeding birds.

Screeding and barging would be required to transport modules to Camden Bay early in the construction period of each development project and could result in displacement and disturbance to normal behavior of birds in the nearshore marine environment. Both screeding and barging would involve slow-moving vessels (7 knots for barges) and produce noise and visual disturbance. Long-tailed ducks make up about 80 percent of the birds in nearshore waters of the Beaufort Sea (Fischer et al. 2002) and are the predominant bird in the lagoon system, which attracts birds because it provides shallow water for feeding and protection from wind and waves (Flint et al. 2004). Flint et al. (2004) reported that molting long-tailed ducks using lagoons in the Beaufort Sea had low but variable fidelity to sites inside barrier islands, averaging 39 percent. Sites were occupied consistently, but turnover of individuals was high as flightless ducks moved among sites. Site fidelity was not clearly affected by disturbance from industrial activity, seismic surveys, or experimental boat disturbance; therefore, the authors concluded that disturbance activities during their study did not result in measurable displacement and that alternate sites of similar quality were available inside the barrier islands (Fischer et al. 2002; Flint et al. 2004). Displacement and disturbance to birds from screeding and barging would be short term and would occur in a relatively small area.

Air traffic supporting any development project in the program area would include aircraft carrying passengers and supplies to the airport in Deadhorse and helicopter support primarily during summer. Use of the Deadhorse airport, which is the primary hub for the North Slope oil industry, would increase both for passenger and freight flights. It is expected that the additional use of the Deadhorse airport would add to disturbance levels there, although traffic levels already are high. Potential impacts to birds would be long term but would be restricted to the area of the airport in Deadhorse; however, birds in this area already experience high levels of disturbance due to current aircraft traffic and airport activities.

Under all action alternatives, helicopters would be used to support ice road layout, survey, and summer cleanup activities, and possibly for spill-response equipment deployment and maintenance. These activities usually take place in July or early August and last approximately four weeks, with daily helicopter traffic during that time, involving departures from the helipad and landings at various tundra locations. Ice road layout, survey activities, and cleanup would occur during construction. Additionally, helicopters may be used in the event of health and safety emergencies, or to support oil spill response activities. Helicopter flights during July and August would occur during nesting, brood-rearing and molting, and fall migration-staging periods for most of the species in the Program Area. Helicopter landings on tundra could cause displacement from nests and separation of broods, which could allow predators to take eggs or young, and thus reduce reproductive output. As young grow and become more mobile or even flight capable, helicopter landings and low-level flights would cause escape movements or flight behavior and interfere with feeding and resting; however, such effects are usually very short-term. The impacts of helicopter flights would be minor to major depending on number of landings on tundra, landing locations, and seasonal timing, would occur during all years and phases, and would be extensive in geographic scope.

All types of air traffic have potential to cause disturbance and displacement of staging snow geese that visit the coastal plain of the North Slope in large numbers in late August and September of most years. As many as 300,000 snow geese have been documented using the program area for several weeks, foraging for cottongrass and equisetum in both coastal and upland habitats and building energy reserves needed by fall migration. They are easily disturbed by aircraft and other human intrusions during staging, making them vulnerable to displacement and potentially significant impacts. Dau and Wisely (1974) documented flushing distances of staging snow geese on the North Slope up to 8 miles from overflying aircraft. Mean distances of flushing for various types of overflights ranged between 1.2 and 2.5 miles and durations averaged between 5 and 6 minutes, depending on overflight category (aircraft and altitude, etc.). Boothroyd (1985) found similar results and found that staging snow geese were the most sensitive waterfowl species in their area to aircraft overflights.

<u>Mortality and Injury</u>

Vehicle and aircraft traffic and tall structures, including communication towers and drill rigs, pose collision hazards that could result in mortality and injuries to birds. Little information is available on rates of mortality or injury from collisions in the North Slope oilfields. Collisions with vehicles and aircraft would probably be correlated to bird densities and traffic rates. Collisions might increase during breeding when birds are less focused on hazards and during brood-rearing when road crossings by flightless birds would occur. Reduced speed limits and driver awareness of seasonal bird vulnerability could reduce collision risk from vehicles.

Tall structures, particularly communication towers, account for 6.8 million bird mortalities in the United States and Canada each year (Longcore et al. 2012). Collisions with tall structures increase with tower height, bright lighting, and the presence of guy wires (Manville 2005; Gehring et al. 2011). Weather conditions such as fog, rain, and low light increased collision mortality of common eiders at towers and transmission lines (MacKinnon and Kennedy 2011). On the North Slope, birds often migrate at low altitudes and in foggy conditions; migrating eiders averaged 40 feet above ground level at Point Barrow (Day et al. 2002). Best management practices eliminating guy wires, reducing tower heights, and shielding lighting would reduce the risk of collisions with facilities in the program area.

Collisions with vehicles, aircraft, or structures would likely cause injuries or mortality to birds. Although the risk of collisions is low, the consequences are high resulting in serious injury or death. Collisions would be expected to occur annually in small numbers, but mortality events could be serious if flocks of birds of conservation concern are involved. The impacts of collisions are short-term in duration (infrequent and seasonal in occurrence) but would occur throughout the life of any development project and would be restricted in extent to the locations of roads and facilities.

Oil spills and other releases of contaminants pose risks of injury or mortality to birds. During exploration and construction activities, the primary potential for release would be accidental spills from vehicles, storage tanks, marine barges and docks, aircraft, and equipment during transport or fueling and during pipeline hydrotesting (see **Section 3.2.11**, Solid and Hazardous Waste). Most spills would involve refined oils, antifreeze, or salt water (used in hydro-testing). Crude oil spills would not be a risk during construction. During drilling and operation, there may be risks of larger spills due to well blowout or pipeline failure.

Very small to small spills are likely to occur, medium-sized spills are possible, and large and very large spills are unlikely. Most spills would be small (<100 gallons) and restricted to ice or gravel roads and pads, never reaching the tundra. Oil spills on tundra or in water are extremely rare as are large spills of >10,000 gallons. Spill containment at strategic points on waterways would likely keep oil from flowing downstream into lagoons. Nonetheless, if oil escaped, many species would be vulnerable. Salt-water spills would not be toxic to birds but would likely kill vegetation in the spill zone and thus alter habitat. Somewhat larger spills, such as tanker truck spills (<10,000 gallons) could reach tundra and contaminate a few birds, nests and eggs, or their habitat and forage, or could reach streams or lakes, which would spread the effect farther and affect more birds and bird habitats. Marine spills would likely be very small to small in volume (<100 gallons), be localized to docking facilities, and with a very low to low frequency of occurrence. Medium to very large spills in the ocean would be possible but very unlikely, requiring a vessel to run aground or somehow have containment compartments breached, and could occur in the shipping lanes leading to the docking or STP pads.

Small spills would be short-term in duration, with restricted extent (one to several acres or less) on land as they are usually being contained on gravel pads and roads. Marine spills would have similar probabilities for similar volumes, but marine spills would occur only during screeding and barging of CPF and STP modules. Large spills would be more extensive, with cleanup activities lasting days to weeks, and could pose contamination risk to large numbers of molting, feeding, or migrating birds.

<u>Attraction to Human Activities and Facilities</u>

Oil development projects in the program area would likely increase the numbers of scavengers and predators in the area, beginning in the construction phase and continuing through operations. The potential for development to attract scavengers and predators is a concern in part because increased predator abundance can result in decreased productivity and increased mortality of nesting birds (Truett et al. 1997; Johnson et al. 2010). Liebezeit et al. (2009) detected reduced nest survival among Lapland longspurs from predation up to 3.1 mi from oilfield infrastructure. Two avian predators, glaucous gulls and common ravens, are attracted to human food (Day 1998, National Research Council 2003) and populations of these species have increased on the coastal plain of the North Slope over the last 10 years (Stehn et al. 2013). On the North Slope, ravens and, to a lesser degree, peregrine falcons, gyrfalcons, and rough-legged hawks nest on man-made structures, including buildings, elevated pipelines, bridges, towers, drill rigs, and wellheads (Ritchie 1991; Frost et al. 2007; Powell and Backensto 2009; Sanzone et al. 2010). Some species of songbirds (e.g., snow buntings, common redpolls) also are attracted to human structures for nest sites. Effective food and garbage control and wildlife interaction plans and personnel training should minimize the attraction of predators to oilfield facilities.

Foxes and bears also prey on birds and their eggs and are attracted to areas of human activity where they readily feed on garbage and handouts (Eberhardt et al. 1982; Follmann and Hechtel 1990; Savory et al. 2014). Foxes also use human structures (gravel berms and empty pipes) for denning and shelter (Eberhardt et al. 1983; Burgess et al. 1993). Development projects would attract some foxes throughout the year, and grizzly bears in summer and fall.

During construction and operation periods, drill rigs, bridges, and other infrastructure would be inspected during March through July, and any nesting materials that may have been placed by ravens would be removed as is practicable and subject to restrictions in the Migratory Bird Treaty Act. The impact of attraction of birds to facilities would vary depending on the species attracted and their predatory effect on species of concern (for example threatened species), long term in duration (extending longer than 5 years), and would affect most of the program area, as predators are far-ranging.

Alternative B

In Alternative B, the entire program area is open to lease. Alternative B includes 266,100 acres designated NSO to protect rivers and streams, although pipeline and road crossings will be allowed. These restrictions offer some protection to birds in riparian areas by limiting potential habitat loss/alteration and disturbance/displacement. Important waterbird habitats in the Canning River delta and adjacent lakes district are included in this NSO. In addition, Alternative B includes 855,400 acres of caribou calving and post-calving habitat in which human activity would be limited when caribou are present between May 15 and July 30. These areas also would offer limited protection to birds from limiting disturbance and displacement (by controls on traffic levels), but only when caribou were actually present.

The most abundant vegetation types in the program area are Herbaceous (Mesic) (31 percent total cover), Tussock Tundra (26 percent), Herbaceous (Wet) (16 percent), and Low Shrub (15 percent). Freshwater or Saltwater (primarily saltwater, as all lagoons are included) comprises 9 percent and no other vegetation type comprises more than 2 percent of the program area. Breeding birds use all of these vegetation types, but greatest abundance and species richness of nesting birds, and potentially

greater direct and indirect habitat and disturbance-related impacts would occur in wetter habitats and in more coastal and deltaic habitats.

Areas available for lease under Alternative B include 427,900 acres in the area of High HCP, 686,500 in Medium HCP, and 476,300 in Low HCP. Areas of High, Medium, and Low HCP have similar cover by vegetation types overall, although areas of Medium and Low HCP include greater proportions of inland habitats, reflected in an increase in occurrence of more well-drained Tussock Tundra and Low Shrub and decreasing occurrence of Herbaceous (Mesic) and Freshwater or Saltwater (again almost entirely saltwater) (see **Section 3.3.1**, Vegetation and Wetlands). Also, two relatively high-quality bird habitats, Herbaceous (Marsh) and Herbaceous (Wet-Marsh) (Tidal) occur primarily in areas of High HCP within the program area.

Assuming a maximum of 2,000 acres of facility footprints (excludes material sites), long term loss and alteration of habitat from direct effects of gravel deposition and indirect effects of dust, thermokarsting, and impoundments with Alternative B would occur over 1 percent of the area available for leasing (i.e., the entire program area). Disturbance and displacement of breeding birds in tundra habitats could occur over about 2 percent of the area available for leasing.

Alternative C

In Alternative C, 476,600 acres are closed to leasing to protect caribou calving habitat and the remaining 1,086,600 acres are available for lease sale. The area closed to leasing comprises entirely inland habitats and nearly all occurs in the area of Low HCP. Although protective of birds, this closure affects mainly drier and inland habitats that are less important for waterbirds and shorebirds. Fall staging snow geese are an important exception, as the area closed to leasing overlaps extensively with areas historically used by the largest numbers of fall staging snow geese. Areas available for lease include 389,800 acres that are designated NSO, including rivers and streams (as in Alternative B), areas within 1 mile of the coast, and additional caribou calving habitat. With respect to bird habitats, the main differences from Alternative B are the 1-mile coastal setbacks in Alternative C. The coastal and riparian setbacks in Alternative C would protect important bird habitat, although as described above, roads and pipelines would be allowed, including docking pads and the STP in the coastal setback. Alternative C also includes an additional 350,700 acres subject to timing restrictions on activities to protect caribou calving and post-calving habitat when caribou are present between May 15 and July 30. NSOs and timing restrictions to protect caribou habitat would offer protection primarily to more inland and drier habitats generally used by smaller numbers of breeding birds. However, lower levels of aircraft traffic in areas closed to leasing and adjacent NSOs to protect caribou calving habitat in Alternative C would result in much lower potential for disturbance and displacement of staging snow geese by comparison with Alternative B.

With Alternative C, long term loss and alteration of habitat from direct and indirect effects of gravel deposition would occur over approximately 1.5 percent of the area available for leasing (1,114,900 acres). Disturbance and displacement could occur over about 3 percent of the area available for leasing.

Alternative D

In Alternative D, 526,200 acres are closed to leasing to protect caribou calving habitat (the same amount as Alternative C) and to protect springs and aufeis, which are important sources of surface water for plants, fish, and wildlife, including birds. As with Alternative C, nearly all of the area closed to

leasing occurs in the area of Low HCP and in inland and drier habitats that are less important to nesting waterbirds but are used extensively by fall staging snow geese. All NSO and timing restrictions would be protective to birds, with the most important avian habitats being in coastal and riparian areas. Areas available for lease include 724,400 acres designated NSO. With respect to important bird habitats, the main differences from Alternative C are in NSO areas: 1) increased coastal setbacks from 1 to 2 miles, 2) increased number and width of riparian setbacks, and 3) additional setbacks in the Canning River delta and adjacent lakes district. All of these setbacks would protect important habitats for breeding and migrating birds, although roads, pipelines, and other facilities would be allowed, including docking pads and the STP in the coastal setback.

Surface use restrictions to protect caribou would also affect birds mainly in more inland and drier habitats. Timing restrictions for caribou, although they would cover much of the program area under Alternative D1, and all of the program area under Alternative D2, would apply only when caribou were present, offering localized protection to birds by reducing traffic rates and speeds only (i.e., where numbers of caribou might be located on any day). However, areas closed to leasing and adjacent NSOs and CSU areas to protect caribou calving habitat under Alternative D also overlap extensively with areas known to be used extensively by fall-staging snow geese. Lower levels of aircraft traffic, in particular, in these areas would result in reduced disturbance and displacement of staging snow geese. As mentioned above, air traffic and other disturbances would likely be low in areas used by the largest numbers of staging snow geese in the southeast portion of the program area that is closed to leasing with Alternative D. However, disturbance and displacement of staging snow geese would occur during fall in areas north and west of protected calving habitat. These areas are used by large numbers of staging snow geese in fall and the timing and other restrictions to protect caribou would not be protective. Fall staging snow geese occur throughout these areas and air traffic and other activities there likely would result in disturbance and displacement.

Under Alternative D, long-term loss and alteration of habitat from direct and indirect effects of gravel deposition would occur over approximately 1.5 percent of the area available for leasing (1,064,900 acres). Disturbance and displacement could occur over about 3 percent of the area available for leasing.

Cumulative Impacts

The past, present, and reasonably foreseeable future actions that have been identified fall into 6 categories: oil and gas development, transportation, subsistence activities, recreation and tourism, scientific research, and community development. Oil and gas development impacts would be common to the impacts described for developments pursuant to the program area lease sale and would increase the occurrence and intensity of these common impacts. Such projects are likely in both terrestrial and marine environments and would affect birds in both. Transportation activities are anticipated to increase in support of both oil and gas development projects and of coastal villages, along with increases in research and recreational transportation. Increased transportation will include overland movement as the road system increases in size, barge and boat traffic, and passenger and cargo air traffic. Future surface, boat, and air traffic will result in increasing levels of disturbance of birds. Subsistence activities involving bird hunting and egg harvesting will continue with similar types of activities and areas used. Future subsistence activities and scientific research are unlikely to negatively affect bird populations. Recreation and tourism have potential to negatively affect birds, depending on locations and seasons, intensity, and types of transport. Air-based sight-seeing has potential to cause widespread disturbance, as do adventure cruise ships. It is assumed that rates of tourist traffic in the Arctic Refuge would be

controlled to minimize negative impacts on wildlife. Community development projects, such as airport improvements, roads and ports, telecommunication, and energy projects, all would affect local birds in the vicinity of such communities but would result in small increases in impacts on bird populations.

Climate change is expected to increase temperatures, increase precipitation, and lengthen the snow-free season (see **Section 3.2.1**, Climate and Meteorology). Summer temperatures above freezing could occur for 6 weeks longer by 2099 (SNAP 2011). Warmer temperatures and earlier snowmelt will likely change the timing of seasonal events on the North Slope, but it is unclear how bird populations will respond. For birds, climate change will affect phenology (seasonal timing of events), habitat and forage availability, and range expansion. It is unclear whether some or all birds will be able to arrive earlier to take full advantage of an earlier and longer breeding season. However, a delay in freeze up in fall should be advantageous to the slow-growing young of species such as loons and swans, who are not always flight capable by time of freeze up. With earlier thaws and snowmelt, insect populations will hatch sooner (McKinnon et al. 2012). Some species of insect-feeders (shorebirds and songbirds) can initiate nests earlier with early snowmelt, whereas others (jaegers, common eiders, raptors) do not, but it is unclear if birds relying on insects to feed their young (songbirds and shorebirds) could adapt to hatch at the optimum time as insect hatch continues to advance (Grabowski et al. 2013). Plant biomass is predicted to increase with warmer temperatures, but forage quality is seasonal. Mismatches in insect abundance and forage quality with timing of bird reproduction would likely have adverse effects on growth rates of young of some species (Dickey et al. 2008; McKinnon et al. 2012).

Avian habitat is likely to change slowly with climate change, with the exception of coastal areas subject to erosion and deposition (see below). Waterbodies in the program area may shrink, depending on the balance of precipitation, evapotranspiration, and drainage from thermokarsting and a deeper active layer in soils. Some shorebirds (particularly phalaropes), waterfowl, and loons could face reduced availability or quality of nesting and brood-rearing habitats (Martin et al. 2009). Increases in shrubs and trees have been documented (Sturm et al. 2001; Tape et al. 2006) and are expected to continue with increasing summer temperatures. If available wet sedge and graminoid meadows are reduced by invading shrubs and decreasing moisture, it may result in shifts in the breeding bird community. Shrub- and tree- nesting birds (passerines such redpolls, sparrows, and thrushes) may become more numerous and tundra nesting birds (longspurs, savannah sparrows, shorebirds, geese, eiders) may decline. With a longer breeding season and increases in shrub and tree cover, breeding species more typical of boreal forest areas to the south may extend their ranges northward and possibly compete with current tundra breeders for nest sites.

Coastal habitats are likely to change quickly with increased water temperature, reduced sea ice, rising sea level, increasing storm surges and wave action. Erosion of barrier islands and ice-rich coastlines from mechanical process and thawing can happen rapidly: current rates of loss along the Beaufort coastline is 2 to 18 m/year (see Martin et al. 2009 for review). River deltas may grow from deposition of sediment, while barrier islands, which form the lagoon areas important to post-breeding birds, may be losing area to storm surges while accreting less material from ice-push events in the future. Erosion of coastal shorelines could increase inundation of tundra by salt water; the resulting salt-killed tundra may be colonized by salt-tolerant species and develop into salt marsh, a rare but important post-breeding habitat for geese (Flint et al. 2003). Climate change would have minor to major effects, depending on the species considered and how dramatically the vegetation and hydrology respond. Some bird species may benefit from longer breeding seasons and expansion of shrub and coastal habitats, others will lose

habitat, food, or prey, and experience seasonal mismatches in breeding and plant/insect phenology. Effects are probable and both negative and positive effects are possible.

3.3.5 Terrestrial Mammals

Affected Environment

Thirty-nine species of terrestrial mammals are known or expected to occur in the Arctic Refuge, 18 of which occur regularly on the Coastal Plain physiographic province in the Arctic Refuge (MacDonald and Cook 2009; USFWS 2015; **Table H-2** in **Appendix H**). The occurrence and distribution of terrestrial mammals in the program area have been described in detail previously (Clough et al. 1987; Douglas et al. 2002; USFWS 2015; Pearce et al. 2018); those discussions are incorporated here by reference, and relevant information is summarized below, supplemented with updates from more recent research.

Special Status Species

None of the terrestrial mammals in the program area are listed under the federal Endangered Species Act. In 2010, the BLM (2010) added to its list of sensitive species the Alaska hare (*Lepus othus*) and the Alaska tiny shrew (*Sorex yukonicus*, which has since been reclassified as the Holarctic least shrew, *S. minutissimus*; Hope et al. 2010; Bradley et al. 2014).

The Alaska hare has not been documented on the North Slope since the late nineteenth century, and the species range has shrunk southward, being confined now to western Alaska (Cason et al. 2016). Arctic hares (*Lepus arcticus*) reportedly occur in the Northwest Territories, approximately 100 miles east of the Arctic Refuge boundary (USFWS 2015); however, they have not been documented in Alaska.

To date, one specimen of the Holarctic least shrew has been captured in the mountains of the Arctic Refuge, south of the program area, at the confluence of the Canning and Marsh Fork Rivers[15]. A previous report of this species from the Canning River delta in 2004 (MacDonald and Cook 2009; USFWS 2015) was based on a misidentified specimen (University of Alaska Museum of the North number 85499). It was subsequently identified correctly as a barren ground shrew (*S. ugyunak).*[16]

Caribou

Caribou are the most abundant large mammals in the program area and are an important subsistence resource for Iñupiaq and Gwich'in hunters in the Arctic Refuge. They also are important for sport harvest by other hunters who do not live in the refuge and for non-consumptive uses, such as tourism and wildlife viewing. Because caribou exhibit high fidelity to calving grounds, the ADFG defines herds based on their use of calving grounds.

Four herds of barren-ground caribou occur in Arctic Alaska (proceeding from west to east): the Western Arctic herd, the Teshekpuk herd, the Central Arctic herd (CAH), and the Porcupine herd (PCH). These four herds differ in their use of seasonal ranges, especially during the calving, insect-relief, and winter seasons (Russell et al. 1993; Murphy and Lawhead 2000). The program area is primarily used by the PCH and the CAH and is far east of the Western Arctic herd range (Dau 2015; Joly and Cameron 2017). The program area is outside the primary range of the Teshekpuk herd, although an

[15] A. G. Hope, Kansas State University, personal communication
[16] A. G. Hope, Kansas State University, personal communication

estimated 5,000–10,000 caribou of the Teshekpuk herd moved into the northern portion of the Arctic Refuge in the fall of 2003, where many died during the winter of 2003–2004 (Person et al. 2007; USFWS 2015); that unprecedented movement was highly unusual and has not been repeated.

The PCH gives birth in the program area during most years and uses the Coastal Plain and ridges in the adjacent foothills and mountains for relief from insect harassment during summer, a period when some CAH caribou also use the program area. For these reasons, this discussion focuses on the PCH and CAH.

Herd Sizes and Trends

The PCH was estimated to number about 100,000 animals in 1972 and increased to 178,000 in 1989, before declining to 123,000 animals in 2001 (Caikoski 2015). Due to unsuitable conditions of weather and herd distribution, another census could not be conducted until 2010, when the herd was estimated at 169,000 animals. It increased to 197,000 animals by 2013 and reached its current peak size of 218,000 in July 2017 (**Figure 3-5** in **Appendix A**; Caikoski 2015; ADFG 2018). Although population dynamics are complex, population growth of the PCH has been correlated with phases of the Arctic oscillation (an index of oceanic temperature and sea-level pressure over the Arctic Ocean), which may affect snowfall and summer growing conditions (Joly et al. 2011).

The CAH was estimated at approximately 5,000 animals when it was first described as a separate herd in the mid-1970s. The herd grew to its estimated peak of 68,000 animals by July 2010, then declined steeply to 23,000 by July 2016; the most recent estimate was 28,000 individuals in 2017 (**Figure 3-5** in **Appendix A**; Lenart 2015b, 2018; ADFG 2017). The herd decline between 2010 and 2016 was thought to be due to high adult mortality and to the emigration of some CAH caribou to the PCH and Teshekpuk herd (ADFG 2017).

Life History and Habitat Use

Caribou behavior and habitat use in northern Alaska vary substantially on a seasonal basis (Russell et al. 1993; Murphy and Lawhead 2000). This is because caribou efficiently travel long distances (Fancy and White 1987) to maximize access to areas of accessible, nutritious forage plants, to minimize the risk of predation, and to limit their exposure to insect harassment.

Caribou of the PCH and CAH spend the winter in or south of the Brooks Range (Griffith et al. 2002; Lenart 2015b; Nicholson et al. 2016), where the winter ranges of the two herds often overlap substantially. Many PCH animals migrate to winter range in the Yukon. During winter, the availability of lichens and other winter forage is influenced strongly by snow depth, snow hardness, and ice (Collins and Smith 1991). Winter snow depth is negatively related to population growth (Aanes et al. 2000), calf birth mass (Adams 2005), and birth rate (Ferguson and Mahoney 1991). Deep winter snow may delay the timing of births and reduce birth rates a year later (Adams and Dale 1998a, 1998b).

In spring, pregnant females migrate northward to calving grounds ahead of non-pregnant females, with males arriving later, after most calving is complete (Russell et al. 1993; Murphy and Lawhead 2000). Spring migration tends to coincide with snowmelt, and caribou often calve farther south when snowmelt is delayed (Carroll et al. 2005) or, in the case of the PCH, farther east (Griffith et al. 2002). In northern Alaska, most adult females older than 2 years of age give birth to a single calf in late May or early June. Caribou calving grounds in Arctic Alaska are in areas with few predators and with abundant, early

emerging forage plants (especially tussock cotton grass, *Eriophorum vaginatum*), which are high in protein and are highly digestible (Kuropat 1984; Griffith et al. 2002; Johnstone et al. 2002). Use of the Coastal Plain during summer appears to extend the period when caribou can find forage with adequate digestible nitrogen (Barboza et al. 2018).

The calving grounds of the PCH and CAH are near coastal mosquito-relief habitat, requiring relatively short movements once mosquitoes become active (Walsh et al. 1992; Murphy and Lawhead 2000; Nicholson et al. 2016). During the summer insect season (late June to mid-August), caribou are influenced heavily by mosquito (*Aedes* spp.) and parasitic oestrid flies (warble fly, *Hypoderma tarandi*; nose-bot fly, *Cephenemyia trompe*) harassment. The longest distances traveled per day throughout the entire year typically occur in July, when mosquito harassment peaks (Fancy et al. 1989; Prichard et al. 2014; Dau 2015). In response to severe mosquito harassment, caribou form large groups and move to relief habitat near the coast or to remnant snowfields, patches of aufeis, and mountain ridges farther inland, where temperatures are lower and wind speeds are higher (Downes et al. 1986; Walsh et al. 1992; Murphy and Lawhead 2000; Wilson et al. 2012).

Oestrid flies emerge in July and exert strong effects on caribou behavior and body condition (Murphy and Lawhead 2000; Hughes et al. 2009). In response to fly harassment, large caribou herds break up and disperse widely in small groups, seeking relief in unvegetated habitats such as river bars, dunes, drained-lake basins, pingos.[17] and ridgetops. In areas of northern Alaska with industrial development, caribou often use elevated sites on gravel roads and pads and in shaded areas under buildings and pipelines when flies are active (White et al. 1975; Pollard et al. 1996; Murphy and Lawhead 2000). Hot summers with severe insect harassment can substantially decrease caribou conditions in fall, causing them to enter the winter in poor condition (Helle and Tarvainen 1984; Colman et al. 2003; Weladji et al. 2003; Couturier et al. 2009).

During late summer and fall, caribou feed heavily to restore body reserves before the onset of winter (Haskell and Ballard 2004; Gustine et al. 2017). The birth rate for female caribou in spring is strongly related to body mass in the previous autumn (Cameron and Ver Hoef 1994; Cameron et al. 2000). On the range of the CAH, the length of the growing season has increased by 15 to 21 days as the climate warmed between 1970 and 2013 (Gustine et al. 2017); despite a 9- to 10-day increase in the fall growing season during that period, no significant change in seasonal forage quality was evident. Caribou migration to winter ranges in the fall coincides with the breeding season (rut) in October, a period when male caribou experience high energy demands. In one study, adult males lost 23 percent of body protein and 78 percent of body fat during the rut (Barboza et al. 2004).

Compared with the conditions experienced by other arctic migratory herds, the range of the PCH has warm spring conditions and cool moist summers, which likely result in longer periods of high plant quality and lower mosquito harassment (Russell and Gunn 2017). The winter range has relatively high snow depths, but diverse terrain provides a wide range of wintering locations. PCH animals accumulate less back fat and get pregnant at higher fall body weights (indicating lower productivity) than other herds, but pregnancy rates change less dramatically with changing fall body weights (indicating lower

[17] A dome-shaped hill formed in a permafrost area when the pressure of freezing groundwater pushes up a layer of frozen ground

vulnerability) and the PCH has had a more stable population size than other herds in recent decades (Russell and Gunn 2017; Fauchald et al. 2017).

PCH Use of the Program Area

Caribou use of the program area varies greatly throughout the year. The principal use by the PCH occurs in the spring and summer, during spring migration and the calving, post-calving, and insect seasons (**Map 3-18, Seasonal Distribution of the Porcupine Caribou Herd** in **Appendix A**). The PCH give birth from the northern portion of the Arctic Refuge into northern Yukon, and the extent of use of those areas varies substantially among years (Map 4-9 in USFWS 2015; (**Map 3-18, Seasonal Distribution of the Porcupine Caribou Herd** in **Appendix A**). Four terms are used to describe the use of calving grounds by caribou, as follows (Russell et al. 2002):

- Annual calving ground—the calving ground for a particular year
- Extent of calving—the outer perimeter of all known annual calving grounds
- Annual concentrated calving area—the area of relatively high use within an annual calving ground
- Extent of concentrated calving—the outer perimeter of all known annual concentrated calving areas

During 1983–2001, the annual percentage of PCH females calving in the ANILCA 1002 area (essentially the program area) averaged 42.7 percent. It was highest in years with early spring conditions (as measured by the Normalized Difference Vegetation Index [NDVI] calculated from satellite imagery during calving; Griffith et al. 2002). In 8 of the 12 years during 2000–2011, the annual concentrated calving areas occurred in the Yukon or near the Yukon-Alaska border, largely outside the program area (USFWS 2015).

The annual calving grounds were in areas with higher rates of increase in NDVI, which is thought to indicate higher quality forage. The annual concentrated calving areas in those annual calving grounds were characterized by higher forage biomass, as measured by NDVI (Griffith et al. 2002). PCH caribou feed primarily on immature flowers of tussock cottongrass early in June, in wet sedge meadows, herbaceous tussock tundra, and riparian vegetation types; then later in June they forage primarily on willows and herbaceous plants (Griffith et al. 2002; Johnstone et al. 2002).

During 1983–1985, PCH calf mortality during June averaged 29 percent, and 61 percent of that mortality was due to predation, primarily by golden eagles, grizzly bears, and wolves. Predation rates and predator densities were higher in the foothills south of the program area (Whitten et al. 1992; Young and McCabe 1997) and calf survival was lower for calves born in the foothills (Griffith et al. 2002). Mean annual calf survival was higher when the forage biomass at peak lactation (estimated by NDVI on June 21) was higher (Griffith et al. 2002); hence, calving grounds for the PCH varied annually at least in part due to spring weather and vegetation growing conditions; and calving location and vegetation growing conditions appear to affect calf survival. The USFWS (2015) concluded that, due to the annual variability in the calving area, the PCH needs a large region from which to select the best conditions for calving in a given year.

During the post-calving season (last week of June and first week of July), most locations of PCH caribou were in the program area, and PCH caribou moved west toward the program area even if they calved outside of it (Griffith et al. 2002). PCH caribou may use both coastal areas and inland ridgetops for

insect relief (Walsh et al. 1992; USFWS 2015). During the summer insect season (July 7–August 14) in the years before 2000, caribou spread out across the Coastal Plain and in the Brooks Range in Alaska and Yukon, with few remaining in the program area (**Map 3-18, Seasonal Distribution of the Porcupine Caribou Herd** in **Appendix A**; Griffith et al. 2002). After 2000, PCH caribou generally left the Coastal Plain by the end of June (USFWS 2015). Most move out of the program area by mid to late summer.

<u>CAH Use of the Program Area</u>

The CAH calves in two areas west of the Arctic Refuge: one south and southwest of the Kuparuk oilfield, between the Colville and Kuparuk Rivers, and the other between the Sagavanirktok and Canning Rivers in an area with little development (**Map 3-19, Seasonal Distribution of the Central Arctic Herd** in **Appendix A**). Since construction of the Alaska North Slope oilfields, the CAH has been exposed to some level of development for about 40 years (Cameron et al. 2015). During most years since 2004, a portion of the CAH has moved through the program area during the summer insect season (**Map 3-19, Seasonal Distribution of the Central Arctic Herd** in **Appendix A**; Lenart 2015b; Nicholson et al. 2016; Prichard et al. 2017).

Coastal movements by large groups of caribou occur during periods of mosquito harassment, with caribou typically moving into the wind (which tends to be easterly); however, those groups tend to break up and caribou disperse when oestrid flies become the dominant insect pests (Murphy and Lawhead 2000).

The number of CAH animals using the program area varies annually, likely in response to weather conditions and the resulting levels of insect harassment.

Muskox

This native species became extinct in Alaska in the nineteenth century; the history, distribution, and habitat preferences of muskoxen were described previously (BLM 2012; USFWS 2015). The current population in northeastern Alaska was reestablished by translocation when 64 animals from Greenland stock were released at Barter Island and the Kavik River in 1969 and 1970 (USFWS 2015). As their numbers increased, they expanded westward on the Arctic Coastal Plain to the Colville River drainage and eastward across the international border to the Babbage River in northern Yukon.

The population in northeastern Alaska and northwestern Canada was estimated at 700–800 animals in the mid-1990s, but it subsequently declined to approximately 300 animals during 2007–2014; about 200 were located west of the Arctic Refuge and 100 were located east of it in northern Yukon (Lenart 2015c; Arthur and Del Vecchio 2017). The decline was especially steep in the Arctic Refuge, where only one muskox was observed in 2006. A group of fewer than 20 animals, which moved back and forth across the Canning River, was the only group using any part of the Arctic Refuge during 2009–2015 (Lenart 2015c). Predation by grizzly bears accounted for 58 percent of calf mortality and 62 percent of adult mortality from 2007 to 2011 (Arthur and Del Vecchio 2017).

Moose

Moose are found in low numbers on the coastal plain of the North Slope where suitable forage plants occur, primarily in riverine habitats dominated by willow shrubs (Lenart 2014; USFWS 2015). Late-winter aerial surveys in 2014 found only 22 moose in a series of drainages that included the program

area, a sharp decrease from the fairly stable number of 47–61 moose found in the same survey area from 2002 to 2010 (Lenart 2014). Moose appear to be expanding their range farther onto the North Slope in response to climate warming and corresponding northward expansion of tall shrubs (Tape et al. 2016).

Carnivores

Three large to medium-sized terrestrial carnivores (grizzly bear, wolf, wolverine) inhabit the Arctic Refuge, occurring in lower densities on the coastal plain of the North Slope than father inland in the foothills and mountains (Young et al. 2002). The USFWS (2015) summarized information on these species.

Grizzly bears and wolves are important predators of caribou and other ungulates. Grizzly bears occupy dens during winter dormancy, whereas wolves and wolverines remain active year-round. Grizzly bear density in Unit 26C, which covers much of the program area, was estimated to be 3.8 bears per 100 square miles in 1993 (Lenart 2015a). Due to the distribution of suitable landforms and substrates, wolf den sites are more common in the foothills and mountains than on the coastal plain of the North Slope (Young et al. 2002; USFWS 2015). Wolf density in Unit 26C was estimated to be 5.7–8.3 per 1,000 square miles in the 1980s (Gardner and Reynolds 1986; Caikoski 2012).

Two species of foxes and two species of weasels inhabit the program area, all which feed on small mammals year-round and on birds and their eggs when available during summer. Arctic foxes inhabit the Coastal Plain during the summer denning season to rear pups but move long distances to forage extensively on sea ice during winter (Pamperin 2008). Red foxes are not known to inhabit sea ice and are increasing in numbers on the coastal plain of the North Slope, in concert with climate warming and increased availability of human food sources in industrial areas (Savory et al. 2014; Elmhagen et al. 2017). Red foxes are aggressive toward arctic foxes and will kill or otherwise displace them from den sites (Pamperin et al. 2006; Stickney et al. 2014).

All species of terrestrial carnivores can be attracted to areas of human activity if food or rotting waste are improperly handled or disposed of. This can lead to habituation and food-conditioning, and thus increasing the risk of injury or mortality to humans or the carnivores themselves (Burgess 2000; Shideler and Hechtel 2000). Increasing predator populations, with its effects on prey populations (especially migrant birds), has been a perennial concern around the North Slope oilfields (Day 1998).

Small Mammals

Small mammals provide important prey resources for predatory mammals and birds in the region, and arctic ground squirrels are especially important prey for grizzly bears and foxes (Babcock 1985). Arctic ground squirrels hibernate during winter, whereas lemmings, voles, and shrews remain active under the snow cover. Most species of small mammals exhibit cyclical population fluctuations, which have pronounced effects on local ecological systems (USFWS 2015). Similar to moose, snowshoe hares appear to be expanding their range farther onto the Arctic Coastal Plain in response to climate warming and corresponding northward expansion of tall shrubs (Tape et al. 2015). Beavers also are expanding their range into parts of Arctic Alaska and the northern Yukon (Tape et al. 2018).

Direct and Indirect Impacts

Lease sales within the program area have the potential to affect terrestrial mammals through habitat loss and alteration, behavioral disturbance and displacement, and injury or mortality as a result of oil and gas exploration and development. The impacts of oil and gas development on caribou have been summarized in various reviews, along with appropriate mitigation measures (Shideler 1986; Cronin et al. 1994; Murphy and Lawhead 2000; Lawhead et al. 2006), which are incorporated here by reference and summarized briefly below, where relevant. Because specific project plans are not available for analysis, the areas available for leasing with and without restriction under each alternative were summarized in relation to the available data on terrestrial mammal distribution and in relation to predicted oil potential. In some cases, previous research on terrestrial mammals in the Arctic was assessed when data was not available.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the program area would be offered for future oil and gas lease sales following the ROD for this EIS. Alternative A would not include the direction under the Tax Cuts and Jobs Act of 2017 to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain within the Arctic Refuge. Under this alternative, current management actions would be maintained and resource trends would continue, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015).

Impacts Common to All Action Alternatives

<u>Seismic Exploration</u>

Seismic exploration is expected to occur in all portions of the program area that are open to lease sales. Seismic exploration has the potential to affect terrestrial mammals by eliminating subnivean (below or within snow) habitat for small mammals, reducing forage availability during winter through compaction of snow and underlying vegetation, and disturbing denning grizzly bears and muskoxen. Occupied dens of grizzly bears detected during den surveys would be avoided by at least one half-mile, assuming all such dens are located on those surveys. The program area is used very little by caribou during winter (Clough et al. 1987; Porcupine Caribou Technical Committee 1993; Ryder et al. 2007), so direct impacts on that species during that timeframe would be negligible. Localized disturbance of the small number of muskoxen along the western boundary of the program area could result from seismic exploration activities in areas of High HCP.

Indirect effects of seismic exploration would include short term compaction of snow cover in foraging habitats for herbivores. The timing of snowmelt during the spring following seismic exploration would change as a result of snow compaction and changes in snow drifting. Delayed snowmelt in the spring could decrease forage available to caribou and other herbivores, but could also extend the time when highly nutritious, early growth forage is available after snowmelt. Some habitat alterations and long-term damage to forage plants for herbivores, such as riparian willow shrub is also likely to occur, as described in the **Section 3.3.1**, Vegetation and Wetlands.

<u>Construction</u>

All action alternatives would potentially result in up to 2,000 acres of direct surface impact from placement of gravel infrastructure on leased land, in addition to gravel mines and associated

development on adjacent land owned by Alaska Native corporations within the program area, but not subject to PL 115-97. The amount of construction activity is expected to be similar across action alternatives, although the spatial distribution and extent of the activities would differ, as described separately for each alternative later in this section.

Using the schematic anchor-field footprint (one CPF and 6 radiating 8-mile access roads to 6 drill pads, including an STP pad and a 30-mile access road, totaling 750 acres), the BLM calculated estimates of the area within 2.49 miles for potential displacement of calving caribou. Using these standardized footprints and extrapolating to a 2,000-acre maximum gravel footprint, it was estimated the total acres of potential disturbance and displacement is 629,000 acres, although this number would vary with different road and pad scenarios. This area is compared with areas available for lease under each alternative.

During winter months, construction activities such construction of ice roads and pads and associated water withdrawals, excavation and placement of gravel for roads, pads, and airstrips, and pipeline installation would affect mammals that are active all year or are denning in the area. Summer construction activities, such as maintenance of gravel roads and pads and continuation of on-pad construction, would potentially cause disturbance for all mammal species using the area in that season.

Construction activities would result in loss and alteration of terrestrial mammal habitats due to gravel placement for roads, pads, and airstrips, as well as from gravel extraction from mine sites. Habitat loss would reduce forage availability for herbivorous terrestrial mammals. For most terrestrial mammals, foraging habitat is abundant across the program area. Habitat loss also would eliminate denning and burrowing habitat for some species of small mammals, but the availability of denning habitat does not appear to be a limiting factor for those species. Gravel fill occasionally may be used for artificial den sites by small numbers of bears and foxes.

Injury and mortality of terrestrial mammals is possible as a result of vehicle strikes on gravel roads and ice roads during construction. Caribou and other mammals attracted by early vegetation greening along gravel roads during spring snow melt would be at increased risk of injury or mortality. Caribou move erratically and unpredictably during the oestrid fly season and often use gravel roads and pads as travel routes and as relief habitat, substantially increasing the risk of vehicle-related injury and mortality during that period. Small mammals in subnivean burrows may be killed because of gravel placement, gravel mining, and ice road construction during winter, or may be killed by vehicles while crossing roads. Bears and foxes attracted to infrastructure may be hazed or, in extremely rare situations, killed in defense of life or property.

Indirect impacts on terrestrial mammals would include habitat alteration, fragmentation, and loss of use because of disturbance and displacement. Habitat near gravel infrastructure is likely to be affected by physical alteration caused by dust deposition, gravel spray, thermokarst, flow alteration, and impoundments. The magnitude of these impacts varies, depending on species, habitat type, volume of ground ice, and hydrologic regime (Brown and Grave 1979; Walker et al. 1987). Habitat alteration would reduce local forage availability for herbivorous mammals, such as caribou, muskox, moose, and some small mammals. Snowdrifts along roads would reduce the availability of winter forage locally for herbivores and delay its availability in the spring. Deposition of fugitive dust on snow, caused by vehicle traffic on gravel roads, would lead to early snowmelt and green-up in affected areas, attracting some caribou in spring before calving and increasing access to early emerging forage. Few data are available on the effects of noise and light on caribou, Tyler et al. (2016) suggested that caribou may avoid powerlines

in winter due to their ability to detect emissions of light in the ultraviolet range. Noise and light associated with vehicles, aircraft, and other human activity is likely to increase the level of disturbance associated with those activities.

Vegetation damage from ice-road construction could reduce the abundance and quality of forage for terrestrial mammals, particularly caribou. The compaction of vegetation could reduce concealing cover for small mammals. Although some habitat damage would result from the use of ice roads and pads, because the ice road is temporary, the long-term impacts would be considerably less than those associated with gravel roads and pads. The land cover types available for development vary by alternative (**Table H-3** in **Appendix H**). Tussock tundra and sedge/grass meadow, are preferred cover classes for caribou. Moose generally prefer tall shrub and riverine landcover types. Drier habitat classes are preferred by arctic ground squirrels and denning foxes. Many other terrestrial mammals in the program area are opportunistic and do not have restrictive habitat preferences.

Disturbance by vehicle traffic, structures, and construction activities, including blasting associated with gravel mining, causes a variety of impacts on the behavior and movements of terrestrial mammals. Some species, particularly bears and foxes, may be attracted to areas of human activity in the program area due to the availability of food or shelter. An increase in red foxes due to anthropogenic food sources could result in a decline in arctic fox densities. Construction activities may disturb grizzly bears in dens that are not found by preconstruction denning surveys.

Potential behavioral effects of disturbance on caribou include displacement of maternal caribou during calving and early lactation (late May to late June), deflection and delays in caribou movements across roads and pipelines during the summer insect season (late June to mid-August), and potentially during spring and fall migrations for the smaller numbers of caribou present in those seasons.

Disturbance could result in behavioral responses such as reduced foraging rates, increased movements, and energetically costly flight responses, and potentially displacing animals from suitable habitat (Shideler 1986; Cronin et al. 1994; Murphy and Lawhead 2000; Murphy et al. 2000). Terrestrial mammals are more prone to displacement from areas with consistently high levels of activity, such as near CPFs, airstrips, and busy sections of trunk roads under all alternatives. The most common disturbing stimulus associated with roads is vehicle traffic; high traffic volumes (15 vehicles per hour or more) have been shown to deflect caribou movements and delay road crossings even in the absence of adjacent pipelines (Curatolo and Murphy 1986; Cronin et al. 1994). Studies of CAH caribou have demonstrated that behavioral reactions are most common when caribou are within 200 m of roads, but the strongest reactions, as measured in displacement distance, occur in response to humans on foot (Curatolo and Murphy 1986; Lawhead et al. 1993; Cronin et al. 1994). Experience in existing northern Alaska oil fields indicates that caribou and other terrestrial mammals may habituate to low-level constant noise and oilfield activities on roads and pads (maternal caribou with young calves being a notable exception). PCH caribou have had much less exposure to human development and activities than have CAH caribou, however, so they would be expected to have stronger reactions to infrastructure than CAH caribou for some years. Some indication of habituation to infrastructure by PCH caribou during winter has been reported (Johnson and Russell 2014).

Research in the Kuparuk and Milne Point oilfields on the central North Slope has demonstrated that, during and immediately after calving, maternal caribou with young calves tend to avoid areas within at least 500–1,000 m of active roads and pads (Johnson and Lawhead 1989; Cronin et al. 1994), and as far

as 1.25 to 2.5 mi (Dau and Cameron 1986; Lawhead 1988; Cameron et al. 1992; Cronin et al. 1994; Nellemann and Cameron 1996; Lawhead et al. 2004). Studies of open-pit mines have recorded more extensive displacement of caribou with a zone of influence extending 11–14 km (Boulanger et al. 2020). A level of displacement of up to 4 km observed at existing North Slope oil fields would be expected in the program area with similar development and mitigation design. Displacement lasts from calving (late May to mid-June) up to approximately 3 weeks of age (Lawhead et al. 2004; Haskell et al. 2006), corresponding to the calving and post-calving periods for the PCH (**Map 3-18, Seasonal Distribution of the Porcupine Caribou Herd** in **Appendix A**).

Of the approximately 1.5 million acres within the program area, 749,000 acres (49.4 percent) is within areas used for annual calving grounds of the PCH at least 40 percent of years; 906,000 acres (59.7 percent) is in areas used for annual calving grounds of the PCH at least 30 percent of years; and 1,060,000 acres (69.9 percent) is in areas used for annual calving grounds of the PCH at least 20 percent of years. All of the area within the annual calving grounds of the PCH at least 30 percent of years is in areas currently thought to have low or medium HCP (**Map 3-18, Seasonal Distribution of the Porcupine Caribou Herd** in **Appendix A**).

Although several potential demographic impacts of development on CAH caribou have been reported (Cameron et al. 2005; Arthur and Del Vecchio 2009), the CAH increased in size between 1978 and 2010 before declining in size between 2010 and 2016 (Lenart 2015b). The patterns of CAH demography following development should be applied to the PCH with caution for several reasons: movements and demography of the PCH are different from the CAH, concentrated calving density of the PCH is much higher than the CAH, and areas adjacent to the PCH calving grounds have higher predator densities than do the current PCH calving grounds (Clough et al. 1987; Griffith et al. 2002).

If development causes large-scale displacement of the PCH from the calving grounds in the program area, the calving distribution would most likely shift to the east or southeast (Griffith et al. 2002) and displacement would be most likely to occur in years of early snowmelt when the PCH is more likely to calve in the program area (Griffith et al. 2002). Comparison of mean annual survival rates of PCH calves during June 1985 and 1987–2001 showed that calf survival was lower in years when higher proportions of calves were born off of the coastal plain and when less vegetative biomass (based on NDVI) occurred on the annual calving ground at the time of peak lactation (June 21; Griffith et al. 2002). Using this model and previous hypothetical development scenarios (Scenarios 2–5 from Tussing and Haley 1999) and assuming that the calving distribution would be displaced 4 km from development, Griffith et al. (2002) predicted that calf survival would decline linearly with the distance that the annual calving ground was displaced and predicted an 8 percent decline in annual calf survival if full development of the 1002 Area (essentially the current program area) occurred. This predicted decline in mean annual calf survival during June would have been large enough to halt herd growth, based on stochastic population simulations of the PCH (Walsh et al. 1995). This analysis assumed no change in the shape of the calving distribution and it was developed from annual comparisons of mean calf survival but has not been tested for a spatial shift in calving within a given year. An eastward shift in the calving distribution would move the calving distribution into areas with higher predator densities (Young et al. 2002) and areas with lower quantity and quality of common caribou forage species and lower proportions of the preferred tussock tundra and moist sedge–willow tundra vegetation types (Jorgenson et al. 2002).

Large aggregations of PCH and CAH making mid-summer movements through the program area during periods of mosquito harassment will have to navigate any existing infrastructure they encounter. Caribou may expend more energy, take more time, or exhibit reduced crossing success where traffic rates exceed 15 vehicles per hour and pipelines are located within 300 feet of roads (Curatolo and Murphy 1986; Cronin et al. 1994; Murphy and Curatolo 1987; Johnson and Lawhead 1989; Lawhead et al. 1993). However, the design (7-foot minimum height at VSMs) and placement (at least 500 feet from adjacent roads) of elevated pipelines have been found to be adequate to maintain caribou passage in the oilfields west of Prudhoe Bay (Cronin et al. 1994; Lawhead et al. 2006). During the oestrid fly season (mid-July to mid-August) elevated gravel roads and pads and shaded areas under buildings and pipelines may provide relief from insect harassment (Curatolo and Murphy 1986; Cronin et al. 1994; Noel et al. 1998).

The presence of roads and pipeline in the program area could also potentially result in delayed and deflected movements during spring and fall. Research has found varied responses of caribou to roads during such migrations. Approximately 30 percent of collared female caribou (8 of 24 individuals) encountering the DeLong Mountains Transportation System (Red Dog Mine road) in northwestern Alaska during fall migration experienced long delays in crossing the road corridor, with the delays of these “slow crossers” averaging 11 times longer than those of “normal crossers” (33.3 days vs. 3.1 days; Wilson et al. 2016). Wild reindeer (the same species as caribou) in Norway were delayed approximately five days during spring migration at a highway corridor experiencing high levels of human activity, but when human activity was low during fall migration the road did not appear to pose an obstruction (Panzacchi et al. 2013). Similar delays have not been observed in caribou within the existing North Slope oil fields, where most movements occur during the summer insect season when movement rates and motivation to cross are much higher (Cronin et al. 1994, Murphy and Lawhead 2000). Caribou crossing success in the program area would vary by season, behavioral motivation, level of habituation, and human activity levels.

Aircraft noise during take-offs and landings could result in the inability of nearby terrestrial mammals to hear biologically important sounds (i.e., predators, prey, or interspecific communication; Barber et al. 2010) and lead to increased stress levels near the airstrip. Low-level aircraft may cause flight responses or temporary changes in caribou behavior (Maier et al. 1998; Reimers and Colman 2006), although most program-related aircraft would maintain minimum flight altitudes to reduce disturbance of wildlife and subsistence hunters. In addition, habituation appears to lower the response of caribou to aircraft activity (Valkenburg and Davis 1985). Some of the limited research on aircraft disturbance on caribou involved military jets. While military jets are likely to have more impact on caribou behavior than the aircraft typically encountered in the program area, these studies provide some information on the range of caribou behavior likely to be encountered. Maier et al. (1998) found that caribou responses to low-level military jet overflights were low in late winter, moderate in midsummer, and strongest during postcalving, with females accompanied by young showing the strongest responses. During the postcalving season, caribou subjected to direct overflights at low altitudes by military jets moved farther and were more active than animals that were not overflown. Lawler et al. (2005) found that responses to military overflights during calving were variable but generally mild and overflights did not result in higher calf mortality or increased movements of cow-calf pairs.

<u>Development Drilling and Operations</u>

Given the 2,000-acre limit on gravel placement, the amount of activity during development drilling and operations is expected to be similar among alternatives, although the spatial distribution and extent of the activity would differ among the alternatives, as described separately below.

Many of the same impacts that occur during construction would persist throughout drilling and operation, although some activities (e.g., gravel hauling, gravel fill placement, pipeline construction) would end and others (e.g., vehicle and air traffic volume) would continue at a lower frequency. Drill rigs and associated activity would introduce additional noise disturbance. Because of the relative levels of activity associated with each phase, the impacts during development drilling would be greater than during operations after drilling ceases.

The effects of habitat loss are long-term in duration and would continue throughout drilling and operations. Additional habitat alterations from the impacts of snowdrifts, dust, thermokarst, and ponding would continue during operations. Accidental oil discharges in the program area may impact terrestrial mammals, depending on the location and size of the spills (see **Section 3.2.11**, Solid and Hazardous Waste). During exploration and construction activities, the primary releases would be accidental spills from vehicles, storage tanks, marine barges and docks, aircraft, and equipment during transport or fueling and during pipeline hydrotesting but the frequency of spills would be limited by BMPs. Most spills would be small (<100 gallons) and restricted to ice or gravel roads and pads, never reaching the tundra, but larger tundra spills are possible. Disturbance from human activities and traffic on roads, pads, and airstrips would continue through drilling and operations. However, the frequency of disturbance would decline during operations in comparison with construction and development drilling. Throughout drilling and operations, it is assumed that maternal female caribou with young calves would continue to avoid active infrastructure by up to 4 km and that caribou moving through the program area during the postcalving and insect seasons would potentially experience delays and deflections when encountering roads and pipelines. Vehicles are likely to strike small numbers of mammals throughout drilling and operations.

Alternative B

<u>Seismic Exploration</u>

Alternative B would open the entire program area to lease sales and seismic activity could potentially occur throughout the program area. Approximately 500 line miles of seismic data is expected to be collected with receiver lines spaced 330-1320 feet apart.

<u>Construction</u>

Under this alternative, surface occupancy would be excluded from areas within 0.5–1 mi of selected river corridors (see Rivers and Streams Lease Stipulation) which would limit disturbance on some potentially important PCH calving areas. Although they did not test specifically for selection of riverine areas, Young and McCabe (1998) found that the mean distance from rivers was closer than expected for PCH caribou but not for grizzly bears in their 1002 study area. Wilson et al. (2012) found that female PCH caribou avoided riverine habitats at both the landscape and patch scale of selection during calving. Jakimchuk et al. (1987) found that female CAH caribou avoided riverine habitat during calving while males selected riverine habitats during that period, although use of riparian areas was partially confounded with industrial development within one river corridor. Development along coastal areas could hinder coastal movements of CAH and PCH animals during mid-summer periods of mosquito

harassment. Alternative B requires an impact and avoidance and monitoring plan to mitigate effects on wildlife along coastal areas (see Coastal Areas Lease Stipulations) but does not limit infrastructure in coastal areas.

Under Alternative B, 264,100 acres would be closed to surface occupancy. The 629,000 acres of potential PCH calving displacement area (based on a displacement of 4 km) would impact up to 49.8 percent of the remaining area, although some of this buffer area would likely fall into the locations with no surface occupancy or out of the program area (**Map 3-20, Porcupine Caribou Herd, Alternatives B, C, D1, and D2 in Appendix A**).

Alternative B would place undefined limits on human activity in the Porcupine caribou primary calving area (see Porcupine Caribou Calving Lease Stipulation) during May 15–June 15 and the Porcupine Caribou Post-calving Habitat Area (see Porcupine Caribou Post Calving Lease Stipulation) during June 15–July 30. The effectiveness of these stipulations would depend on which limitations on human activity are enacted, but density of infrastructure as well as activity such as vehicle traffic, aircraft, and human foot traffic affects caribou use of calving areas (Curatolo and Murphy 1986; Nellemann and Cameron 1998; Cameron et al. 2005) and without adequate limitations, calving displacement likely would occur, as described above. If sufficient infrastructure is developed within the area of concentrated calving for the PCH during most years, displacement of calving caribou could lead to decreased calf survival as described above. Some level of displacement of calving caribou has been shown to occur even with low levels of traffic (Dau and Cameron 1986; Lawhead 1988, Lawhead et al. 2004). Caribou avoidance of roads in other seasons appears to be positively related to the intensity of the disturbance (Leblond et al. 2013). Hence, it is not possible to predict the effectiveness of this stipulation without defining the limitations, but infrastructure development with even low levels of human activity may result in some calving displacement.

The Porcupine caribou calving habitat area would not be subject to specific limitations after June 15 (the lease stipulation defines the time period as the period when caribou are present [generally May 15–June 15]) although the area is used extensively by the PCH during the postcalving period (PCTC 1993). As a result, some impacts to caribou distribution and movements may occur in this area during the postcalving period although caribou exhibit less displacement from properly designed infrastructure during the postcalving period compared to the calving period.

A total of 16.7 percent of the Tussock Tundra land cover type in the program area would be off-limits to lease sales or surface occupancy (**Table H-3** in **Appendix H**). Of the high use PCH calving area (area used in greater than 40 percent of years), Alternative B would place 135,800 acres (18.1 percent) off-limits to lease sales or surface occupancy, place timing limitations on 589,700 acres (78.8 percent), and leave only 23,100 acres (3.1 percent) with no restrictions (**Table H-4** in **Appendix H**).

Of the high use PCH postcalving area (area used in greater than 40 percent of years), Alternative B would place 107,200 acres (19.2 percent) off-limits to lease sales or surface occupancy, place timing limitations on 451,200 acres (80.8 percent) and leave only 1,000 acres (0.01 percent) with no restrictions (**Table H-5** in **Appendix H**).

Alternative B would place an area predicted to contain 0.2–1.4 percent of the CAH during different seasons off limits to lease sales or surface occupancy, place timing limitations on an area predicted to contain 0.3–1.9 percent of the CAH during different seasons, and put no restrictions on an area

predicted to contain 0.5–3.3 percent of the CAH during different seasons (**Table H-6** in **Appendix H**). Because these percentages represent seasonal averages, the percentage of CAH animals moving through these areas during a season may be substantially higher. Hence, much of the seasonally important areas for the PCH in the program area are open to surface occupancy but subject to timing limitations under Alternative B and the impacts of this alternative on caribou will depend, in large part, on how well these timing limitations avoid displacement of calving caribou and impediments to caribou movements during other times of year when caribou are present.

<u>Development Drilling and Operations</u>

Impacts under Alternative B during the drilling and operations phase would be similar to the construction phases. Many of the same impacts that occur during construction would persist throughout drilling and operation, although some activities (e.g., gravel hauling, gravel fill placement, pipeline construction) would end and others (e.g., vehicle and air traffic volume) would continue at a lower frequency. These impacts would be long-term, lasting for at least the period of development and range in extent from the area of the gravel footprint to within 4 km of infrastructure as described above.

Alternative C

<u>Seismic Exploration</u>

Alternative C would close the Porcupine Caribou primary calving area (see Stipulation 7, **Chapter 2**) to lease sales or to surface occupancy, seismic activity could occur in areas of the program area open to lease sales. The closure of the approximately 653,000 acres in the southwestern portion of the program area would limit potential impacts from seismic activity (e.g., destruction of subnivean small mammal habitat, disturbance of denning mammals, crushing of forage species, alterations in snowmelt timing) in the area that is used for PCH calving during most years.

<u>Construction</u>

Under Alternative C, 795,000 acres (52.5 percent of the program area) would be closed to lease sales or surface occupancy. The potential 629,000 acres of PCH calving displacement (based on a displacement of 4 km) would impact up to 87.3 percent of the remaining area, although some of this buffer area would likely fall into the locations with no surface occupancy or out of the program area. Because there would be no change from Alternative A, no impacts are expected within these areas under Alternative C.

Alternative C would close the areas within 0.5–1 miles of selected rivers (see Rivers and Streams Lease Stipulation), and 606,200 acres of Porcupine Caribou calving habitat area to lease sales or to surface occupancy (see Porcupine Caribou Calving Lease Stipulation). This could limit impacts to caribou in potentially important calving areas as described above.

Alternative C would place undefined limits on human activity in 126,800 acres of the Porcupine Caribou Calving Habitat Area (see Porcupine Caribou Calving Lease Stipulation) during May 15–June 15 and within the Porcupine Caribou Post Calving Habitat Area (see Porcupine Caribou Post Calving Lease Stipulation) during June 15–July 30. The effectiveness of these stipulations would be dependent on which limitations are enacted as described above. Hence, it is not possible to predict the effectiveness of this stipulation without defining the limitations, but the presence of infrastructure with even low levels of human activity may result in some calving displacement.

Alternative C would not allow wells or CPFs within 1 mile of the coast (see Coastal Areas Lease Stipulation), PCH and CAH caribou form large, fast-moving aggregations along the coast in response to mosquito harassment, this stipulation would lower the potential for infrastructure to hinder these movements. Pipelines and roads could still be allowed by the authorized officer, but with proper design, caribou are generally able to navigate these structures especially following habituation and with low levels of vehicle traffic (Cronin et al. 1994; Murphy and Lawhead 2000, Lawhead et al. 2006).

A total of 54.6 percent of the Tussock Tundra land cover type in the program area would be off-limits to lease sales or surface occupancy (**Table H-3** in **Appendix H**). Of the high use PCH calving area (area used in greater than 40 percent of years), Alternative C would place 621,800 acres (83.1 percent) off-limits to lease sales or surface occupancy, place timing limitations on 104,700 acres (14.0 percent) and leave only 22,200 acres (3.0 percent) with no restrictions (**Table H-4** in **Appendix H**).

Of the high use PCH postcalving area (area used in greater than 40 percent of years), Alternative C would place 439,200 acres (78.6 percent) off-limits to lease sales or surface occupancy, place timing limitations on 119,200 acres (21.3 percent) and leave only 1,000 acres (<0.01 percent) with no restrictions (**Table H-5** in **Appendix H**).

Alternative C would place an area predicted to contain 0.3–2.1 percent of the CAH during different seasons off limits to lease sales or surface occupancy, place timing limitations on an area predicted to contain 0.3–1.5 percent of the CAH during different seasons, and put no restrictions on an area predicted to contain 0.4–3.0 percent of the CAH during different seasons (**Table H-6** in **Appendix H**). Because these percentages represent seasonal averages, the percentage of CAH animals moving through these areas during a season may be substantially higher. Hence, much of the seasonally important areas for the PCH in the program area is closed to surface occupancy under Alternative C but a smaller percentage of the area as well as some concentrated calving areas used in less than 40 percent of years are subject to timing limitations and the impacts of this alternative on caribou will depend, in large part, on how well these timing limitations avoid displacement of calving caribou and impediments to caribou movements during other times of year when caribou are present.

<u>Development Drilling and Operations</u>

Additional impacts under Alternative C during the drilling and operations phase would be similar to the construction phases. Many of the same impacts that occur during construction would persist throughout drilling and operation, although some activities (e.g., gravel hauling, gravel fill placement, pipeline construction) would end and others (e.g., vehicle and air traffic volume) would continue at a lower frequency. These impacts would be long-term lasting for at least the period of development and rage in extent form the area of the gravel footprint to within 4 km of infrastructure as described above but the areas of no surface occupancy would have no additional impact relative to Alternative A.

Alternative D

<u>Seismic Exploration</u>

Alternative D would close the Porcupine Caribou Calving Area to lease sales, but seismic activity could occur in the rest of the program area with potential impacts to terrestrial mammals described above activity (e.g., destruction of subnivean small mammal habitat, disturbance of denning mammals, crushing of forage species, alterations in snowmelt timing). Prohibition of winter activity within 1 mi of polar bear

denning habitat (see Lease Stipulation 5 in **Chapter 2**) an area that would likely also include some grizzly bear dens, due to similar habitat preferences.

Construction

Alternative D would close the areas within 0.5–4 mi of selected rivers (see Rivers and Streams Lease Stipulation), areas of the Canning River Delta (see Canning River Delta Lease Stipulation), areas within 1–4 selected springs and aufeis and the area within 3 mil of the east bank of the Canning River (see Springs/Aufeis Lease Stipulation), all 733,000 acres of the Porcupine Caribou Calving Habitat Area (see Porcupine Caribou Calving Lease Stipulation), and areas within 3 miles of the wilderness border (see Wilderness Boundary Lease Stipulation) to lease sales or to surface occupancy. Because there would be no change from Alternative A, no impacts are expected in these areas for Alternative D. The limits on surface occupancy near rivers and on the Canning River Delta would ensure that development would not hinder caribou movements in these areas. The Canning River Delta is used by large numbers of CAH caribou during mid-summer in some years (**Table H-6** in **Appendix H**). One muskox group has often used the area along the Canning River in recent years; limiting infrastructure in this area would limit alterations to the movements of this group.

Under Alternative D, 1,175,000 acres (77.5 percent of the program area) would be closed to lease sales or surface occupancy. The potential 629,000 acres of PCH calving displacement (based on a displacement of 4 km) is larger than the 340,000 acres of the program area remaining open to surface occupancy.

Alternative D-2 would have limits on vehicle and aircraft activity (see Caribou Summer Habitat Lease Stipulation), including limiting the use of heavy equipment from May 20 to July 20 and limits on vehicle use and speed and aircraft use and altitudes would be implemented from May 20 to July 20. Traffic could also be stopped throughout a defined area for up to 4 weeks to prevent displacement to calving caribou. These limits would lower the probability of displacement of caribou during calving and delays in caribou movements or caribou disturbance during summer. High traffic volumes (15 vehicles per hour or more) have been shown to deflect caribou movements and delay road crossings even in the absence of adjacent pipelines (Curatolo and Murphy 1986; Cronin et al. 1994).

The Porcupine Caribou Post Calving Habitat Area (see Porcupine Caribou Post Calving Lease Stipulation) would prohibit CPFs within the Porcupine Caribou Post Calving Habitat Area and limit human activity during June 15–July 30 for Alternative D-1. Density of infrastructure affects caribou use of an area during calving and creates additional barriers for caribou movements during summer (Nellemann and Cameron 1998; Cameron et al. 2005).

Alternative D would not allow wells or CPFs and would restrict vessel activity within 1 mi of the coast (see Coastal Areas Lease Stipulation), PCH and CAH caribou form large, fast-moving aggregations along the coast in response to mosquito harassment. Hence this stipulation would lower the potential for infrastructure to hinder these movements. Pipelines and roads could still be allowed by the authorized officer, but with proper design, caribou are generally able to navigate these structures especially following habituation and with low levels of vehicle traffic (Cronin et al. 1994; Murphy and Lawhead 2000, Lawhead et al. 2006).

A total of 78.6 percent of the Tussock Tundra land cover type in the program area would be off-limits to lease sales or surface occupancy (**Table H-3** in **Appendix H**). Of the high use PCH calving area (area used in greater than 40 percent of years), Alternative D would place 727,300 acres (97.1 percent) off-limits to lease sales or surface occupancy, control use in 5,400 acres (0.7 percent), and place timing limitations (Alternative D1) or place no restrictions (Alternative D2) on the remaining 16,000 acres (2.1 percent; **Table H-4** in **Appendix H**).

Of the high use PCH postcalving area (area used in greater than 40 percent of years), Alternative D would place 501,700 acres (89.8 percent) off-limits to lease sales or surface occupancy, control use on 56,800 acres (10.2 percent) and place timing limitations (Alternative D1) or place no restrictions (Alternative D2) on less than 1 acre (**Table H-5** in **Appendix H**).

Alternative D would place an area predicted to contain 0.6–3.8 percent of the CAH during different seasons off limits to lease sales or surface occupancy, control use in an area predicted to contain 0.1–0.8 percent of the CAH during different seasons and put no restrictions (Alternative D1) or timing limitations (Alternative D2) on an area predicted to contain 0.3–1.9 percent of the CAH during different seasons (**Table H-6** in **Appendix H**). Because these percentages represent seasonal averages, the percentage of CAH animals moving through these areas during a season may be substantially higher. Hence, most of the seasonally important areas for the PCH in the program area are closed to surface occupancy under Alternative D, but some concentrated calving areas used in less than 40 percent of years will be subject to no restrictions (Alternative D1) or timing limitations (Alternative D2).

Cumulative Impacts

Subsistence hunting of caribou has probably occurred in the program area for millennia (USFWS 2015). Most terrestrial mammals in the program area currently have little interaction with infrastructure. There is permanent development associated with the community of Kaktovik as well as use of the area by subsistence hunters, sport hunters, scientists, and recreationists. Far-ranging species such as caribou may encounter the Dempster Highway and other development in the Yukon (Johnson and Russel 2014), communities south of the program area, or oil and gas development west of the program area. Caribou of the CAH have had some interaction with oil and gas development for approximately 40 years.

The use of roads by local hunters to achieve access to subsistence hunting areas may alter the distribution of hunting activities in the area and could further displace caribou and other mammals away from gravel roads, potentially delaying habituation. However, hunting is allowed along most roads in Alaska, including some roads that bisect caribou herd ranges (Boertje et al. 2012).

Caribou body condition and population fluctuations have been found to be influenced by large-scale climate oscillations such as the Arctic Oscillation (Griffith et al. 2002; Joly et al. 2011; Mallory et al. 2018). Climate change is expected to increase temperatures, increase precipitation, and lengthen the snow-free season (see **Section 3.2.1**, Climate and Meteorology). Summer temperatures above freezing could occur for 6 weeks longer by 2099 (SNAP 2011). Climate change in the Arctic is predicted to have multiple, sometimes counteracting, effects on barren-ground caribou (Martin et al. 2009; Albon et al. 2017; Mallory and Boyce 2017). Vegetative biomass in the arctic has generally increased since 1984, although the increase in Alaska has been lower than the increase in eastern Canada (Ju et al. 2016). An increase in shrub cover and a decline in terricolous lichens (lichen growing on soil) has been documents in the western Canadian Arctic (Fraser et al. 2014).

A longer snow-free season can increase access to forage (Cebrian et al. 2008; Tveraa et al. 2013), but warmer summers could increase insect harassment (Weladji et al. 2003), increase the incidence of parasites, and speed the annual decline in forage quality (Gustine et al. 2017). Changes in vegetation composition could result in increased abundance of shrubs and deterioration of forage quality (Fauchald et al. 2017). Increase moose densities could increase predator densities and alter predator distributions.

Changes in winter precipitation could change access to forage and energetic demands for cratering through snow. Increases in rain-on-snow events could greatly decrease access to winter forage (Hansen et al. 2011; Loe et al. 2016). Changes in timing of snowmelt and vegetative growth could potentially create a phenological mismatch between timing of calving and emergence of highly nutritious forage (Post and Forchhammer 2008). Gustine et al. (2017) found no evidence of a spring trophic mismatch for caribou in Alaska but suggested that one may occur in fall with increased warming. If mosquito emergence occurs closer to calving, it could result in a higher rate of separation of calves, poorer body quality of maternal caribou, and higher calf mortality. Earlier melting of ice and snow and earlier river break-up could alter the timing or difficulty of caribou migrations (Sharma et al. 2009; Leblond et al. 2016).

Table 3.3.5-1
The type, context, and duration of potential effects of seismic exploration, construction, and drilling and operation on terrestrial mammals.

Project Component	Potential Effect	Type	Context	Duration
Seismic Exploration	Elimination of subnivean habitat for small mammals	Adverse	Site-specific	Short-term
	Disturbance of active or denning mammals during winter	Adverse	Local	Short-term
	Change in phenology or damage to forage plants	Adverse/ Beneficial	Site-specific	Short-term/Long-term
Gravel and Pipeline Infrastructure	Habitat loss from gravel fill placement	Adverse	Site-specific	Long-term
	Habitat alteration due do drifted snow, gravel spray, and dust deposition adjacent to gravel infrastructure	Adverse	Local	Long-term
	Early snowmelt due to dust deposition	Beneficial	Local	Long-term
	Displacement of caribou from infrastructure during calving.	Adverse	Planning area-wide	Long-term
	Attraction of caribou to roads and gravel pads during oestrid fly harassment.	Beneficial	Local	Long-term
	Disturbance and altered behavior due to noise and activities associated with construction and drilling and operation.	Adverse	Local	Long-term
	Alteration of normal movement patterns and fragmentation of habitat due to roads and pipelines	Adverse	Local	Long-term
	Injury or mortality of large mammals due to vehicle strikes on gravel roads	Adverse	Site-specific	Long-term
	Injury or mortality of small mammals due to vehicle strikes on gravel roads	Adverse	Site-specific	Long-term
	Injury or mortality of small mammals in subterranean burrows	Adverse	Site-specific	Long-term

Table 3.3.5-1
The type, context, and duration of potential effects of seismic exploration, construction, and drilling and operation on terrestrial mammals.

Project Component	Potential Effect	Type	Context	Duration
Ice Roads and Pads	Habitat alteration due to drifted snow, delayed ice melt, vegetation compression, and hydrologic alteration from ice roads	Adverse	Local	Short-term
	Displacement from ice roads and ice pads due to noise and activity	Adverse	Local	Short-term
	Injury or mortality due to vehicle strikes on ice roads	Adverse	Site-specific	Short-term
	Injury and mortality of small mammals in subnivean habitats	Adverse	Site-specific	Short-term
Gravel Mine	Habitat loss due to gravel mining	Adverse	Site-specific	Long-term
	Habitat alteration from dust, water displacement, and hydrologic alteration at gravel mine	Adverse	Local	Long-term
	Displacement from gravel mine due to noise and activity	Low	Local	Long-term

Climate change is also likely to result in a northward expansion of some mammal species such as moose, beaver, and snowshoe hare. A potential increase in red foxes due to warming could cause a decline in arctic foxes. Some species with low reproductive output in the Arctic, such as grizzly bears, may benefit from increased productivity and a more diverse prey base.

Because climate change could involve both adverse and beneficial effects on caribou, it is not possible to predict the impacts on the PCH and CAH, but climate change could affect caribou demographics as well as habitat use and introduces additional uncertainty into projections of impacts due to development. The PCH calving distribution varies with spring phenology and is typically farther west during warmer springs (Griffiths et al. 2002). Hence, climate warming could result in more frequent calving within the program area or a western shift in concentrated calving areas. Development alternatives that limit development to a smaller portion of previously used PCH calving grounds will allow caribou greater flexibility to adapt to changing conditions. Additional oil development that could occur west of the program area could increase the proportion of the year CAH caribou are exposed to development which could potentially alter their behavior and movements and with very high levels of interaction, have potential demographic impacts (Murphy et al. 2000).

3.3.6 Marine Mammals

Affected Environment

All marine mammals found in US waters are protected under the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 USC 1631 et seq.). Some species receive additional protection under the ESA (16 USC 1531 et seq.). Whales, seals, and porpoises are managed by the National Marine Fisheries Service (NMFS), whereas polar bears and walruses are managed by the USFWS.

Eight species of marine mammals have been recorded in marine waters within 5 nautical miles (NM) of the program area (**Table 3.3.6-1**): polar bears, two species of baleen whales, two species of toothed whales, and four species of pinnipeds. The bowhead whale is listed as endangered under the ESA, and

Table 3.3.6-1
Marine Mammal Species Occurring within 5 NM of the Arctic Refuge Coastline and Their Status in the Program Area

Common Name	Scientific Name	Status	Occurrence[3]
Bowhead whale	*Balaena mysticetus*	Endangered[1]	Common
Beluga	*Delphinapterus leucas*	Depleted[2]	Common
Gray whale	*Eschrichtius robustus*	Depleted[2]	Casual
Harbor porpoise	*Phocoena phocoena*	Protected[2]	Casual
Bearded seal	*Erignathus barbatus*	Threatened[1]	Fairly common
Ringed seal	*Phoca hispida*	Threatened[1]	Common
Spotted seal	*P. largha*	Depleted[2]	Rare
Walrus	*Odobenus rosmarus*	Protected[2]	Casual
Polar bear	*Ursus maritimus*	Threatened[1]	Common

Source: -
Notes:
[1] Under the ESA; listed species are considered depleted under the MMPA
[2] Under the MMPA
[3] Common = recorded in every year; fairly common = recorded in most years; uncommon = recorded once every 3–5 years; rare = within its normal range but recorded less than every 5 years; casual = beyond its normal range, further observations unlikely. Occurrence is based primarily on data from the Aerial Surveys of Arctic Marine Mammals Program funded by Bureau of Ocean Energy Management (BOEM) and NOAA.

the polar bear and bearded and ringed seals are listed as threatened. Other species that occasionally occur in the Beaufort Sea are ribbon seal (*Phoca fasciata*), minke whale (*Balaenoptera acutorostrata*), humpback whale (*Megaptera novaeangliae*), narwhal (*Monodon monoceros*), and killer whale (*Orcinus orca*). The program area is well outside the normal range limits of these five species, so they are not expected to occur within 5 nautical miles (NM) of the program area; therefore, the discussion below focuses on the ESA-listed species and the beluga whale, which occurs commonly near shore and is of interest for subsistence harvest.

Polar Bear

<u>Distribution</u>

Polar bears have a circumpolar distribution in the Northern Hemisphere, around the rim of the Polar Basin and into the seasonally ice-covered regions of contiguous seas. In Alaska, they occur most commonly within 200 miles of the coast of the Arctic Ocean (Amstrup and DeMaster 1988). Nineteen subpopulations (stocks) of polar bears have been identified throughout their range, ranging from several hundred to several thousand animals each and totaling 20,000–25,000 individuals range-wide (Schliebe et al. 2006; Amstrup et al. 2007; Obbard et al. 2010).

Bears from three stocks occur in US waters off Alaska: the Northern Beaufort Sea stock, the Southern Beaufort Sea (SBS) stock, and the Chukchi Sea stock (Bethke et al. 1996; Amstrup 2003a; Amstrup et al. 2004a; Schliebe et al. 2006; Obbard et al. 2010). The ranges of the 19 subpopulations of polar bears have been grouped into four ecoregions, based on the distribution and characteristics of sea ice and corresponding population movements (Amstrup et al. 2007). The SBS stock occupies the Divergent ecoregion, where sea ice forms annually but is exported to other ecoregions or else melts and retreats to the central portion of the Polar Basin. Polar bears in this ecoregion either move with the retreating ice or abandon it to spend the summer on land (Durner et al. 2009).

The SBS stock ranges over an expansive area, extending from Icy Cape and Point Hope on the Chukchi Sea coast of Alaska eastward to Cape Bathurst in the Northwest Territories of Canada, and seaward at least 185 miles from the coast (Amstrup 2000, 2002; Bethke et al. 1996; Brower et al. 2002; Schliebe et al. 2006). The core activity area of the SBS stock encompasses a considerably smaller region from Herschel Island, Yukon, to Point Barrow, Alaska, and seaward about 85 miles (Amstrup 2000); thus, the program area is in the core activity area of the SBS.

Species Status

Following a status review (Schliebe et al. 2006), the USFWS listed the polar bear as a threatened species under the ESA in May 2008 (73 FR 28212). Although the species already was covered by the MMPA, the ESA listing automatically triggered the designation of polar bear stocks as depleted, strategic stocks under the MMPA. The ESA listing decision was based on the present or threatened destruction, modification, or curtailment of polar bear habitat or range, focusing on the threat to polar bear habitat posed by rapidly diminishing sea ice cover and thickness in the Arctic Ocean due to climate change, primarily during summer (73 FR 28212; Durner et al. 2009).

The continuing loss of sea ice was judged to put polar bears at risk of becoming endangered throughout their range in the foreseeable future. Subsequent modeling analyses predict that declining sea ice cover risks significant declines in polar bear populations within three generations (35–41 years; Regehr et al. 2016). Considerable research has focused on changes in population status and survival because of diminishing sea ice habitat. Regehr et al. (2010) documented decreases in vital rates, including survival and breeding rates, corresponding to increases in the number of ice-free days per year in waters over the Beaufort Sea continental shelf (including waters adjoining the program area).

The best available data suggest that the SBS population is declining (USFWS 2010, in Muto et al. 2018; Obbard et al. 2010; Bromaghin et al. 2015). The SBS stock was estimated at 1,526 individuals (95 percent confidence interval: 1,211–1,841) in 2006 (Regehr et al. 2006). This estimate was used in the most recent stock assessment to calculate a minimum population size of 1,397 animals for management purposes (USFWS 2010, in Muto et al. 2018).

Demographic modeling based on data collected during 2001–2006 projected population growth in years with extensive sea ice cover and declines in years with low ice coverage, primarily as a result of decreased female survival (Hunter et al. 2010). The analysis of population trends did not show a statistically significant decline during 2001–2006; nevertheless, annual survival rates of cubs of the year and recruitment[18] of yearlings were lower and body size of subadult bears and adult females declined from earlier periods. This suggests reduced nutritional status and a declining population (Regehr et al. 2006; Rode et al. 2010). Most recently, mark-recapture modeling from 2001 to 2010 estimated the SBS stock at approximately 900 individuals by 2010 (90 percent confidence interval: 606–1,212), with low survival from 2004 through 2006 leading to a decline of 25 to 50 percent (Bromaghin et al. 2015).

Human activities that can affect polar bears are regulated by the USFWS under both the MMPA and ESA, with the former law taking precedence in the permitting process regarding incidental take. Government agencies charged with approving permits for a development project must consult with the

[18] The increase in population as offspring grow and immigrants arrive

USFWS under Section 7 of the ESA regarding the potential effects of the project on polar bears and designated critical habitat.

The principal mechanism for regulating human activities is the review and approval of Incidental Take Regulations (ITRs). These were established under Section 101(a)(5) of the MMPA for 5-year periods to regulate the nonlethal, incidental, and unintentional taking (Level B harassment) of small numbers of polar bears. Take is permitted under the ITRs, provided that it results in negligible impacts on the species and does not have an unmitigable adverse impact on the availability of the species for subsistence use by Alaska Natives. Activities related to oil and gas exploration and development in the Beaufort Sea region of Alaska currently are subject to an ITR rulemaking in effect from August 2, 2016, to August 2, 2021 (81 FR 52276). This includes measures to avoid or minimize conflicts with humans.

In addition to the two US federal laws, polar bears are protected under several international agreements. They live in geographic areas under the jurisdiction of five nations—Russia, Norway, Denmark, Canada, and the US—and in international waters, where jurisdiction is not clearly defined. In November 1973, representatives of these five nations developed the Agreement on the Conservation of Polar Bears and Their Habitat, which was ratified in 1976 (Schliebe et al. 2006). In September 2015, these nations adopted the Circumpolar Action Plan for the Management and Conservation of Polar Bears. The polar bear was listed in 1975 as an Appendix II species under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

Polar bear harvesting is legal for Alaska Natives under the MMPA. The mean annual harvest of Alaska stocks declined from 39 bears during 2000–2004 to 32 bears during 2004–2008 (DeBruyn et al. 2010). The potential biological removal (PBR)[19] for the SBS stock was estimated at 22 bears per year, based on the 2006 population estimate (USFWS 2010, in Muto et al. 2018).

<u>Population Movements</u>

Polar bears of the SBS stock range over large areas, with total annual movements of radio-collared animals ranging from 872 to 3,846 miles and covering annual activity areas of 2,805 to 230,426 square miles (Amstrup et al. 2000). The largest monthly movements occur during early winter and the smallest in early spring; females with cubs move less and cover smaller areas than do males and other age classes. Movements are increasing as sea ice cover diminishes. From 1979 to 2006, collared female polar bears moving from the pack ice to denning areas onshore experienced an average increase in travel distance of 3.7 miles per year (104 miles over 28 years) (Bergen et al. 2007).

The increasing difficulty for polar bears dealing with ecological changes, resulting from declining sea ice cover related to climate change has led to changing behavior, as follows:

- Increased frequency of long-distance swimming by collared bears (Durner et al. 2011)
- Observations of swimming bears and dead bears in open water (Monnett and Gleason 2006; Schliebe et al. 2006)
- Polar bear predation and cannibalism (Amstrup et al. 2006a)

[19] Defined under the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock, while allowing it to reach or maintain its optimum sustainable population

- Unusual predation behavior (Derocher et al. 2000; Brook and Richardson 2002; Stirling et al. 2008)
- Increased time spent onshore (Atwood et al. 2016; Wilson et al. 2017)

Polar bears in the SBS stock experienced twice as many days of reduced sea ice during 2008–2011 than did those in the Chukchi Sea stock. Despite similar diets, SBS bears were smaller and in poorer condition and exhibited lower reproduction; twice as many were fasting in spring (Rode et al. 2014).

Consuming terrestrial foods is judged to be insufficient to offset the loss of ice-based hunting. Cascading negative effects on polar bear populations are predicted as sea ice declines (Rode et al. 2015), the availability of high-energy prey decreases, and given the high metabolic demands and increased movements of polar bears (Pagano et al. 2018).

Polar bears typically use land only during late summer, autumn, and the maternal denning season in winter; besides denning females, females with cubs and subadult males occasionally come ashore. Polar bears begin to appear on the mainland and barrier islands in July and August, during the open-water period; by the time of minimal ice extent in mid- to late September, the pack ice can be very far from shore (Miller et al. 2006; Schliebe et al. 2008). As seasonal and pack ice cover spreads southward in the late fall and winter, polar bears move with it, appearing along the Beaufort Sea coast (Amstrup et al. 2000), although some may remain on pack ice all year, if there is continuous access to prey (Stirling 2009).

The number of bears observed on coastal surveys in the fall was significantly related to the distance of pack ice from shore (Schliebe et al. 2008; Wilson et al. 2017). Except for pregnant females that remain to den, bears using land begin to leave when sea ice develops, usually by late October (Schliebe et al. 2001; Kalxdorff et al. 2002). Rapid environmental changes from lengthening of the ice-melt season and diminished sea ice cover has increased the bears' use of terrestrial habitats: the percentage of collared female SBS bears coming ashore tripled over 15 years since the late 1990s, with bears arriving onshore earlier, staying longer, and departing later (Atwood et al. 2016). The mean duration of the open-water period increased by 36 days in that period, and the mean length of stay increased by 31 days.

It has been known for a long time, as stated by several Alaska Native informants (in USFWS 1995), that polar bears become increasingly abundant on the mainland and barrier islands during the open-water season in late summer and the fall subsistence whaling season. USFWS biologists flew 53 aerial surveys along the entire Beaufort Sea coast between Point Barrow and the Canada border in fall 2000–2014, averaging 64 bears per survey and recording a maximum of 156 bears on a single survey in August 2012 (Wilson et al. 2017). On average, 4 to 8 percent of the bears in the SBS stock were observed on land per survey (Schliebe et al. 2008). Most sightings on those coastal surveys (82 percent) were recorded on barrier islands, with 11 percent on the mainland and 6 percent on landfast ice (74 FR 56068).

Peak numbers generally occurred in late September and early October (USFWS 1995; Schliebe et al. 2001, 2008; Kalxdorff et al. 2002). Bear numbers onshore have increased in autumn in certain locations, with the greatest concentrations occurring at Barter Island, Cross Island, and Point Barrow; here, bears feed on bone piles of butchered bowhead whales taken during the autumn subsistence hunt (Miller et al. 2006; Schliebe et al. 2008; Atwood et al. 2016). Genetic sampling and mark-recapture analysis estimated that 228 individual bears (at least 15 percent of the SBS stock) visited the whalebone pile in Kaktovik

during the winter of 2010–2011 alone (Herreman and Peacock 2013). The number of polar bears onshore is related to sea ice dynamics, although the distribution of bears onshore was most strongly influenced by the availability of food from subsistence whaling (Wilson et al. 2017).

Life History

Polar bears are large, long-lived (29-32 years) carnivores that reach reproductive maturity relatively late in life and have comparatively high survival rates, especially after attaining maturity; females bear relatively few young in their lifetimes and exhibit an extended period of maternal care (Amstrup 2003a). Mating occurs from March to late May or early June, when both sexes are active on the sea ice. Adult males and non-pregnant females are active all year, excavating dens in snowdrifts only for temporary shelter during severe weather. Pregnant SBS females construct and enter snowdrift natal dens in October or November (Amstrup and Gardner 1994) and give birth in late December or early January. Mothers and cubs emerge from natal dens in late March or April, when the cubs are 3 to 4 months old (Lentfer and Hensel 1980; Amstrup and Gardner 1994; Smith et al. 2007). The cubs remain near the dens for up to 2 weeks (Smith et al. 2007) as they adapt to outside temperatures. Cubs usually stay with their mothers until they are 1.5 to 2.5 years old, although some may remain into their third or fourth year (Stirling et al. 1975). Females breed again at about the same time they separate from their young, resulting in a breeding interval of females that successfully wean cubs of 3 years or longer. The most common litter size is two, followed by one; triplets occur infrequently.

Polar bear distribution is influenced primarily by prey abundance on seasonal ice (Smith 1980). Ringed seals are the primary prey of polar bears in the Beaufort Sea. To a lesser extent, bears also prey on bearded seals, Pacific walrus, and beluga whales, and they feed on carrion, including whale, walrus, and seal carcasses found along the coast (Amstrup 2003a; Schliebe et al. 2006). Carrion washed ashore can provide particularly important food sources for subadults and females with cubs (USFWS 1995; Miller et al. 2006).

Polar bears occasionally eat small mammals, bird eggs, and vegetation when other food is not available. They are curious and opportunistic hunters and may approach human developments in search of food. Polar bears are vulnerable to oil spills because they rely on fur instead of blubber for insulation, and fouling of their fur by oil quickly causes heat loss (Geraci and St. Aubin 1990).

Critical Habitat

Effective January 6, 2011, the USFWS designated critical habitat for polar bears in Alaska (75 FR 76086). In response to a legal challenge, the US District Court for Alaska vacated that designation in January 2013, but that decision was overturned by the US Court of Appeals for the Ninth Circuit in February 2016 (*Alaska Oil and Gas Association* v. *Jewell*, No. 13-35919), effectively reinstating the final rule designating critical habitat.

Three units of critical habitat (all of which occur in the program area; **Map 3-21, Polar Bear Habitat** in **Appendix A**) were designated, corresponding to the following primary constituent elements (PCEs) of critical habitat described in the final rule:

- Unit 1—Sea-ice habitat, used for feeding, breeding, denning, and movements, in US territorial waters extending from the mean high-tide line seaward over the continental shelf to the 984-foot depth contour

- Unit 2—Terrestrial denning habitat, on land along the northern coast of Alaska, with habitat characteristics suitable for capturing and retaining snow drifts of sufficient depth to sustain maternal dens through winter and containing an estimated 95 percent of all known historical terrestrial dens within 20 miles of the coast, between the US-Canada border on the east and the Shaviovik and Kavik Rivers on the west (including the program area), and within 5 miles of the coast from the Shaviovik and Kavik Rivers west to Point Barrow
- Unit 3—Barrier island habitat, used for denning, refuge from human disturbance, and movements along the coast for access to denning and feeding habitats, comprised of barrier islands and associated mainland spits, along with the water, ice, and terrestrial habitat within 1 mile of those features, the no-disturbance zone.

The final designation of critical habitat excluded human-made structures and the land on which they were located, on the effective date of the final rule. In addition, seven specific areas were excluded, consisting of the communities of Barrow (now called Utqiaġvik) and Kaktovik and five US Air Force radar sites—Point Barrow, Point Lonely, Oliktok Point, Bullen Point, and Barter Island.

<u>Habitat Use</u>

Polar bears are strong swimmers but rely principally on the availability of sea ice habitats to roam, hunt, breed, den, and rest. Although polar bears use island and coastal mainland habitats as well as sea ice, Amstrup (2003a) noted that only 7 percent of the weekly locations of satellite-collared polar bears during 1985–2001 were on land, and most of those involved denning females (described further below).

Preferred habitats are in the active seasonal ice zone that overlies the continental shelf and associated islands and in areas of heavy offshore pack ice (Stirling 1988; Durner et al. 2004, 2009). Adult males usually remain there, rarely coming ashore (Amstrup and DeMaster 1988). Habitat use changes seasonally with the formation, advance, movement, retreat, and melt of sea ice (Amstrup et al. 2000; Ferguson et al. 2000; Durner et al. 2004, 2009; Schliebe et al. 2008). During winter and spring, polar bears tend to concentrate in areas of ice with pressure ridges, at floe edges, and on drifting seasonal ice at least 8 inches thick (Stirling et al. 1975, 1981; Schliebe et al. 2006); the greatest densities occur in the latter two categories, presumably because those habitats provide greater access to seals. Use of shallow water is greatest in winter, in areas of active ice with shear zones and leads (Durner et al. 2004). Use of landfast ice increases in spring during the pupping season of ringed seals. Multiyear ice is selected in late summer and early autumn as the pack ice retreats to its minimal extent (Ferguson et al. 2000; Durner et al. 2004).

<u>Maternal Denning</u>

In comparison with known denning concentrations in other parts of the species' range, such as Wrangel Island in the Chukchi Sea, the Southern Beaufort Sea is an area of widespread, low-density denning by maternal polar bears (Amstrup 2003a, Schliebe et al. 2006). The total number of dens occupied annually by females of the SBS stock has been estimated at 140 to 240 (Amstrup and Gardner 1994; 75 FR 76099).

Of 90 dens of radio-collared females located during 1981–1991 in the Beaufort Sea region, 53 percent were on drifting pack ice, 42 percent were on land, including barrier islands, and 5 percent were on landfast ice (Amstrup and Gardner 1994). Dens on land were mainly in a narrow band along the coast, extending inland a maximum of 38 miles. Amstrup (2003b) summarized similar information on 186

maternal dens during 1982–2003 in his Beaufort Sea study area between Point Hope, Alaska, and the Mackenzie River in northwestern Canada. Of those, 48 percent were on drifting ice and 52 percent were on land or landfast ice.

A more recent analysis documented notable shifts in the distribution of maternal dens in northern Alaska by comparing 124 den locations used by 85 collared SBS bears between an early period (1985–1994) and a later period (1997–2004), documenting a landward and eastward shift in maternal denning along the Beaufort Sea coast (Fischbach et al. 2007). The proportion of dens on drifting sea ice decreased from 62 percent in the early period to 37 percent in the later period, and proportionately fewer dens occurred on pack ice in the western Beaufort Sea in the later period.

An analysis of temperature-sensor data from radio-collars confirmed an increase in land-based denning from 1985 to 2013. This was due to the increased distance to sea ice offshore; females that spent more time on land in summer were more likely to den there (Olson et al. 2017). Across all of these studies, the proportion of dens on land increased through time. The increasing proportion of bears denning on land in the Beaufort Sea region initially was attributed to the restriction of hunting after 1972 (Stirling and Andriashek 1992; Amstrup and Gardner 1994); however, more recently, the landward and eastward shift in denning by SBS bears has been related to reductions in stable sea ice cover and delays in autumn freeze-up (Fischbach et al. 2007; Olson et al. 2017). Because of their greater proximity to settlements, industrial sites, and other coastal areas of human activity, dens on land and landfast ice are more vulnerable to disturbance by human activity than are dens on sea ice.

Pregnant polar bears denning in terrestrial habitats excavate maternal dens in compacted snow drifts next to coastal banks of barrier islands and mainland bluffs, river, stream, and lake banks, and other areas with suitable topographic relief (Amstrup and DeMaster 1988; Durner et al. 2001, 2003, 2006). In the program area, 46 maternal dens have been documented in terrestrial habitats, 18 of which were located between the Katakturuk and Sadlerochit River drainages in the central portion of the program area; 12 other dens were found on sea ice within 5 miles of the program area and in Arctic Refuge wilderness south of the program area (**Map 3-21, Polar Bear Habitat** in **Appendix A**). The dens in this sample were found using a variety of methods; most were found by radio-tracking bears collared with very high frequency (VHF) radio-collars or satellite transmitters during 1989–2010, whereas others were found through opportunistic encounters or dedicated searches from as early as 1913 to as recently as 2010 (Durner et al. 2010).

The most important characteristic of maternal denning habitat is the presence of topographic features of sufficient height and slope to catch blowing snow and form persistent drifts in early winter, with at least 4.3 feet of vertical topographic relief and steep slopes (mean 40°, range 15.5–50°) (Amstrup and DeMaster 1988; Durner et al. 2001, 2003, 2006). Using a combination of methods, USGS biologists characterized and mapped landscape features (bank-habitat segments) considered to provide suitable maternal denning habitat along the Alaska Beaufort Sea coast, from the NPRA to the Canada border (Durner et al. 2001, 2003, 2006, 2013; **Map 3-21, Polar Bear Habitat** in **Appendix A**). They delineated and quantified potential habitat using remote sensing, aerial-photo interpretation, and ground-truthing, correctly classifying about 90 percent of the potential habitats mapped (Durner et al. 2006).

In the program area, 1,462 miles of bank habitats were delineated in the Arctic Refuge, between the Canning River and the international border. Since then, radar also has been used to detect suitable denning habitat, producing similar results (Durner and Atwood 2018).

Other researchers have developed a three-dimensional spatial model, integrating snow physics, weather data, and a high-resolution digital elevation model to predict the occurrence of potential denning habitat along the Beaufort Sea coast (Liston et al. 2015). All of these techniques provide fine-scale results to focus aerial surveys of denning habitat using thermal imaging (forward-looking infrared radiometry, or FLIR) equipment. This is the most suitable method of searching large areas for maternal dens in advance of seismic exploration or other potentially disturbing activities (York et al. 2004; Owyhee Air Research 2018).

Female polar bears do not show fidelity to specific den locations, but they tend to den on the same pack ice or land from year to year and may return to the same general area to den (Amstrup and Gardner 1994; Amstrup 2003a; Schliebe et al. 2006; Fischbach et al. 2007). Fischbach et al. (2007) noted that more females shifted from sea ice to land during both periods studied and that females in the later period showed greater fidelity to land for denning.

Bowhead Whale

Bowhead whales transit past the program area during fall migration in September and October, traveling along the shelf break and coming close to shore to feed (Quakenbush et al. 2010; Citta et al. 2015; **Map 3-22, Bowhead and Beluga Whale Sightings** in **Appendix A**). Bowhead whales were listed as endangered under the predecessor of the ESA in 1973, but no critical habitat has been designated. The decline in extent and duration of sea ice over the past 40 years has coincided with an increase in harvest by residents of Kaktovik, who harvested 1–2 whales per year during 1973–1988 and 2–4 whales per year during 1989–2000 (Koski et al. 2005). The Western Arctic population of bowhead whales increased at a rate of 3.2–3.7 percent from 1978 to 2011 (Schweder et al. 2009; Givens et al. 2013), and the current population estimate is 16,000 (Muto et al. 2018).

Ringed Seal

Ringed seals are year-round residents in the Beaufort Sea (USFWS 2010; Muto et al. 2018). They use sea ice as a platform for pupping in the winter and early spring, molting in early summer, and resting throughout the year (Kelly et al. 1988). They may also use haul-out sites on land for molting and resting when sea ice is absent (Lukin et al. 2006).

The decline in extent and duration of sea ice cover is the primary conservation concern leading to their listing as threatened under the ESA in 2012. During the summer, ringed seals forage along ice edges offshore and in productive open water (Harwood et al. 2015), including waters within 5 NM of the program area (**Map 3-23, Seal Sightings** in **Appendix A**). The population trends and status of this stock are currently unknown (Muto et al. 2018), but there are indications that ocean conditions have been favorable for ringed seals recently: ringed seals near Kaktovik are growing and maturing faster and at a younger age now than 30 years ago (Quakenbush et al. 2011).

Bearded Seal

Bearded seals are associated with offshore pack ice throughout the year, remaining close to the ice edge for as long as the ice is available. They use ice as a platform for breeding, pupping, molting, and resting. In summer, bearded seals may use nearshore areas of the Beaufort Sea (**Map 3-23, Seal Sightings** in **Appendix A**), although they rarely haul out on land (Muto et al. 2018). The primary conservation concern for this species is the ongoing and projected loss of sea ice cover (Cameron et al. 2010), which led to their listing as threatened under the ESA in 2012.

No reliable population estimate and no reliable data on trends of population abundance are available for the entire Alaska stock of bearded seals (Muto et al. 2018). The most recent abundance estimate for bearded seals in US waters (299,174 individuals; 95 percent confidence interval: 245,476–360,544) applies only to the Bering Sea (Conn et al. 2014). Residents of Kaktovik hunt bearded seals as part of their subsistence activities, but seals are not considered a primary food source (Clough et al. 1987).

Beluga Whale

Belugas also use waters in the eastern Beaufort Sea but stay farther offshore than bowhead whales, typically beyond the shelf break (Hauser et al. 2014). They do occasionally approach shallow water to molt or feed (Suydam 2009) and have been recorded within 5 NM of the program area (**Map 3-22, Bowhead and Beluga Whale Sightings** in **Appendix A**). No recent reliable population estimate is available for the Beaufort Sea beluga stock (Muto et al. 2018), but trend data suggest that the stock is at least stable (Harwood and Kingsley 2013).

Direct and Indirect Impacts

In 2016, NMFS released its Final Environmental Impact Statement on Effects of Oil and Gas Activities in the Arctic, which summarized much of the information gathered for marine-mammal studies during the last several decades. That document (NMFS 2016) provides detailed descriptions of marine mammal population status and trends, distribution, seasonal migration and movements, habitat use, reproduction and growth, survival and mortality, hearing and other senses, and potential impacts of industrial activities in the arctic marine environment, and is incorporated into this EIS by reference.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the program area would be offered for future oil and gas lease sales following the ROD for this EIS. Alternative A would not include the direction under the Tax Cuts and Jobs Act of 2017 to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain within the Arctic Refuge. Under this alternative, current management actions would be maintained and resource trends would continue, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). There would be no direct or indirect impacts to marine mammals under Alternative A.

Impacts Common to All Action Alternatives

The following actions and environmental consequences would be common to all action alternatives, although the extent of activities allowed and the areas affected would differ somewhat under each alternative, as described later in this section. All the action alternatives would affect large areas of the designated terrestrial denning unit of critical habitat for polar bears; any facilities constructed within 20 miles of the coast would be located in that critical habitat unit.

<u>Habitat Loss and Alteration</u>

POLAR BEAR

For polar bears, direct loss or alteration of maternal denning habitat would potentially result from gravel mining, gravel and ice road construction, changes in natural drainage patterns (impoundment), and off-pad snow disposal. The permanent, direct loss of polar bear habitat as a result of oil and gas leasing-related construction would primarily involve the terrestrial-denning unit of critical habitat, defined as all

onshore land area within 20 mi of the coastline in the program area (**Map 3-21, Polar Bear Habitat** in **Appendix A**) and constituting 77 percent (1,222,300 acres) of the program area. At 4.8 percent (76,600 acres) and 0.1 percent (1,400 acres), respectively, the areas of the sea ice and barrier island critical habitat units potentially affected by program-related activities would be much smaller.

It is important to note that not all portions of the terrestrial-denning unit of critical habitat represent suitable maternal denning habitat, however, because of local topography and the distribution of suitable habitat characteristics across the landscape. Specifically, potential maternal denning habitat (Durner et al. 2001, 2006; **Map 3-21, Polar Bear Habitat** in **Appendix A**) covers an estimated total of 1,815 miles and 9,600 acres among the three zones of estimated hydrocarbon potential, assuming an average segment width of 21 feet (Durner et al. 2001), constituting the high-priority area that would need to be searched in den surveys before exploration or development activities occur (**Table 3.3.6-2**). To date, the occurrence of maternal dens has been disproportionately high in the high-potential zone, where 53 percent of known dens occurred in 29 percent of the potential habitat mapped. In contrast, the occurrence of dens in the low-potential zone has been disproportionately low, with only 4 percent of known dens occurring in 25 percent of the potential habitat. The occurrence of dens in the medium-potential zone has been proportional to the amount of potential habitat.

Table 3.3.6-2
Number of Documented Dens and Extent of Potential Terrestrial Denning Habitat for Maternal Polar Bears within the Three Zones of Estimated Hydrocarbon Potential in the Program Area.

		Habitat Metrics	
Hydrocarbon Zone	Number of Dens	Total Length of Bank-Habitat Segments (miles)	Estimated Area of Bank-Habitat Segments (acres)
High	25 (53%)	528 (29%)	2,800 (29%)
Medium	20 (43%)	845 (47%)	4,400 (46%)
Low	2 (4%)	442 (24%)	2,400 (25%)
Total	47	1,815	9,600

Notes:
Bank-habitat segments mapped by USGS (Durner et al. 2006); see **Map 3-21, Polar Bear Habitat** in **Appendix A.**
Acreage estimates assume an average width of 21 feet per mapped segment of bank habitat (Durner et al. 2001) and are rounded to the nearest 100 acres.

Temporary loss or alteration of polar bear denning habitat would result primarily from the construction of ice roads and pads, which persist for one winter season. The effects of ice placement in potential denning habitat would be temporary until the ice road or pad thawed during spring melt, although annual reconstruction in the same location would result in perennial loss of use of the specific bank-habitat segment affected. Because ice placement would not affect the topographic characteristics that create the favorable denning conditions, no long-term effects on habitat suitability would be expected to occur. The effects of construction of ice and gravel roads and pads and pipelines would create the potential for temporary loss of use of suitable denning habitat through behavioral disturbance (described further in the next section below). The ITR/Letter of Authorization (LOA) process requires that surveys of potential denning habitat be conducted within a 1 mi buffer zone surrounding the proposed locations of roads and pads. The use of FLIR sensors has proven to be an effective means of locating dens in such surveys, as has the use of specially trained dogs (Amstrup et al. 2004b; York et al. 2004; Perham 2005;

Shideler 2015). Even so, those survey methods do not provide perfect detection and occupied maternal dens are sometimes missed in preconstruction surveys.

Water withdrawal from lakes for the construction of ice roads and pads would not be likely to cause adverse effects on polar bear habitat, provided that no occupied maternal dens occur within 1 mi of the withdrawal sites or ice roads used for access. Similarly, the presence of snow dumps and drifts in the vicinity of oil and gas facilities probably would have negligible effects on polar bear habitat, inasmuch as they are unlikely to be located on or near bluff habitats.

Most polar bears moving through areas near industrial facilities would likely be disturbed by activities on, or be hazed away from, drill-site pads. Disturbance from traffic on access roads would likely alter the use of habitats by bears nearby, although those effects would diminish for facilities located farther inland because they would be less likely to be used by bears than other areas near the coastline. Overall, the effects of reduced use of habitats near oil and gas facilities likely would be minimal, although they would be long-term in duration.

In summary, the effects of temporary habitat loss and alteration on polar bears are expected to be minor to negligible in view of the mitigation required by the ITRs currently in place. After the placement of gravel pads and roads during the construction phase, the attractiveness of some potential maternal denning habitat in the vicinity of infrastructure likely would be diminished because of the presence of the facilities and associated human activity.

SEALS

For ringed and bearded seals, alteration of benthic foraging habitat could result from modification of the seafloor profile caused by dredging or screeding operations at a barge landing site. The size of the affected area would be similar among the action alternatives, regardless of which possible landing site is used (one on Camden Bay near the mouth of March Creek and the other farther east, between Griffin and Humphrey points (Clough et al. 1987). The exact amount of habitat to be altered would depend on the local bathymetry and the placement of the barge landing site. Loss or alteration of marine mammal habitats may also result from accidental releases of hazardous materials (including oil spills) that reach the distributary channels of rivers and streams and adjacent marine waters. The probability, volume, and potential spread of different types of spills are discussed in **Section 3.2.11**, Solid and Hazardous Waste. The probable direct loss and indirect alteration of seal habitat would be minor to negligible in magnitude and short term in duration.

<u>Disturbance and Displacement</u>

All three action alternatives would result in a similar level of disturbance and displacement of marine mammals. Because the number of barge landing locations and the marine transport component of reasonably foreseeable development plans do not differ among the action alternatives, neither would the effects of the activities associated with marine transport and STP development and operation (facility noise, dredging or screeding, and transportation) on marine mammals. Polar bears and seals would experience direct behavioral effects and indirect habitat loss from disturbance caused by human activities and noise associated with ice road and barge transportation (vehicle passage and noise), dredging or screeding for marine barge docks, human activities at camps, and oil spill response planning and drills. During the seasons of open-water barge transport, large vessel traffic would have the potential to disturb or displace whales, seals, and possibly polar bears by the temporary disturbance of

water and by creating strong low-frequency underwater sounds (Richardson et al. 1995). Terrestrial activities and facilities are not expected to have an effect on the behavior of whales or bearded seals because they do not generally approach within 1.2 mi of the coast.

Polar Bear

Noise and visual disturbance from human activity and operation of equipment, especially aircraft and vehicle traffic, have the potential to disturb polar bears nearby (Blix and Lentfer 1992; MacGillivray et al. 2003; Perham 2005; Schliebe et al. 2006; USFWS 2006, 2008, 2009; Andersen and Aars 2008). The greatest concern is disturbance of maternal females during the winter denning period, which could result in den abandonment and reduced survival of cubs (Amstrup 1993; Linnell et al. 2000; Lunn et al. 2004; Durner et al. 2006). Polar bear dens are known to occur onshore in relatively high numbers in the Program Area (**Map 3-21, Polar Bear Habitat** in **Appendix A**) and the incidence of terrestrial denning by the SBS population is increasing (Fischbach et al. 2007; Olson et al. 2017), so the potential for disturbance of dens during the drilling, construction, and operational phases of development projects is of concern.

Amstrup (1993) reported that 10 of the 12 denning polar bears he examined tolerated exposure to a variety of disturbing stimuli near dens with no apparent change in productivity (survival of cubs). Two females denned successfully on the south shore of a barrier island within 1.7 mi of an active oil processing facility and others denned and produced young successfully after a variety of human disturbances near their dens. During winter 2000–2001, two females denned and successfully produced young within 1,312 ft and 2,625 ft of remediation activities being conducted on Flaxman Island (MacGillivray et al. 2003), located just northwest of the Arctic Refuge boundary. In Amstrup's (1993) study, several females responded to disturbance early in the denning period by moving to other sites, leading him to surmise that females may be more likely to abandon dens in response to disturbance early in the denning period than later. Amstrup (1993) suggested that initiation of intensive human activities during the period when females seek den sites (October to November) would give them the opportunity to choose sites in less-disturbed locations. Abandonment later in the denning period exerts greater effects on productivity: survival was poor for cubs that left dens prematurely in response to the movement of sea ice (Amstrup and Gardner 1994) and females that remained in dens through the end of the denning period had much higher cub survival than did females that emerged from dens early (Rode et al. 2018).

Experimental studies of noise and vibration in artificial (human-made) "dens" have been used to estimate the distances at which disturbance may occur. Blix and Lentfer (1992) reported that snow cover greatly attenuated sounds and concluded that activities associated with oil and gas exploration and development, such as seismic surveys and helicopter overflights, would not be likely to disturb denning bears at distances greater than 328 ft from dens. In a more rigorous study, however, MacGillivray et al. (2003) compared noise levels inside and outside of artificial dens at sites on Flaxman Island during a variety of industrial remediation activities, including passage by different vehicles and overflights by helicopters at various distances. Snow cover provided an effective buffer, reducing low-frequency noise by as much as 25 db and high-frequency noise by as much as 40 db for activities conducted near the artificial dens. The noise levels produced by various stimuli were detectable above background levels at ranges from 0.3 mi to 1.24 mi, however, depending on the stimulus. Low-frequency vibrations and noises were detected at the greatest distances. The most audible disturbance stimuli measured from inside the dens was an underground blast, detectable in artificial dens up to 0.8 mi from the source, and

airborne helicopters directly overhead. Helicopters were detectable above background levels as far away as 0.6 mi, but the authors noted that noises just above background are not likely to cause biologically significant responses (MacGillivray et al. 2003). The authors noted that high variability in the tolerance of different bears to noise and disturbance, including hazing with acoustic deterrents, was an important factor in evaluating human disturbance.

Den surveys using FLIR sensors or trained dogs would be conducted annually before seismic exploration and construction of roads and pads commenced in the program area, as stipulated by the LOAs and polar bear interaction plans that would be required. If dens are detected within a 1-mi buffer zone around the proposed locations of roads and pads, then the facility locations would be moved outside of that radius to avoid dens, as required by the ITRs to reduce the effects on occupied dens to a negligible level. If dens are located after ice roads and pads are built, then traffic restrictions and emergency closures would be instituted. Such discoveries typically trigger emergency road restrictions and 24-hour monitoring until the bears depart the dens, as prescribed in typical polar bear interaction plans.

Blasting at gravel mines and pile-driving of bridge abutments during winter construction would be sources of noise in polar bear denning habitat. Pile-driving would occur at bridge crossings over rivers. Pile driving in or near water is known to produce strong underwater noise levels (e.g., Greene and Moore 1995; Blackwell et al. 2004) and, along with gravel blasting, would be one of the noisiest activities resulting from construction. The level of received sound at any specific distance from pile-driving depends on the water (or ice) depth in which the piles are driven, the density or resistance of the substrate, bottom topography and composition (e.g., mud, sand, rock), the physical properties and dimensions of the pile being driven, and the type of pile-driver that is used (Richardson et al. 1995; Blackwell et al. 2004). Winter blasting and pile-driving are likely to disturb some polar bears. Possible impacts on polar bears exposed to noise potentially include disruption of normal activities, displacement from foraging and denning habitats, and displacement of maternal females and young cubs from dens.

Besides potential disturbance of denning females with young cubs, displacement of nondenning bears from preferred coastal habitats would be another potential impact. USFWS based the 1-mi no-disturbance zone of the barrier-island unit of critical habitat on the mean distance (5,032 ft; range = 1,667–9,081 ft) at which maternal females with young cubs on Svalbard in April and May reacted to direct approach by snowmobiles (Anderson and Aars 2008). Medium-sized single bears (subadults) in that study also reacted at fairly long distances (mean: 3,806 ft) and adult males and females without cubs were the least reactive (means: 1,070 and 538 ft). Besides reacting at longer distances, maternal females and subadults showed stronger responses than did adults without cubs.

Polar bears passing near infrastructure in the program area would be exposed to a wide variety of potentially disturbing stimuli resulting from exploration, drilling activities, pipeline and pad construction and other human activity on the pads, vehicles on pads and interconnecting access roads, barge traffic in the lagoon system and associated offloading operations at marine docks, and spill-response drills. A wide variety of behavioral responses by polar bears is likely to occur, ranging from avoidance by maternal females with young cubs in spring to approach by curious bears or those attracted by the numerous odors emanating from the pads (discussed further below). In several previous analyses, the USFWS (2006, 2008, 2009) concluded that the types of activities typical of oil and gas exploration, development, and production projects were not likely to have population-level effects on polar bear populations at the levels analyzed because the behavioral responses of individual bears were short term and localized.

The net direction of movement by maternal females leaving terrestrial denning areas with young cubs is northward, potentially requiring crossing of roads and pipelines, except in portions of the program area with higher densities of dens, the number of such encounters likely would be small. The greatest likelihood for numbers of bears to encounter program-related infrastructure and activities is along the coast during the open-water season (mainly July–October), as bears move eastward along the coast and gather near the Kaktovik whalebone pile in advance of the formation of seasonal ice. Early detection of bears by trained bear monitors and other project personnel would allow industrial activities to be modified to minimize disturbance of bears moving through the vicinity. The completion of barging in summer would reduce the potential for those activities to disturb bears moving along the shoreline, although some encounters are likely to occur in July and early August. Barge traffic operating in open water may cause some short-term disturbance of bears swimming in the ocean, but the likelihood of such encounters is low.

Polar bears moving along the coast through the Kuparuk and Prudhoe Bay oilfields routinely encounter human-made obstructions and are able to cross or move past them without difficulty, resulting in short-term disturbance at most (USFWS 2008, 2009). Short term behavioral responses are not likely to have population-level effects and thus are considered less problematic than are den disturbance and abandonment (USFWS 2008, 2009). The effects of short term behavioral disturbance are likely to be negligible on the SBS population, although the magnitude may increase in the future with increasing terrestrial presence of bears in late summer and autumn. Polar bears spending more time on land and fasting more as sea-ice cover diminishes are likely to experience an increase in negative effects on energy budgets as a result of reduced access to fat-rich prey (Molnár et al. 2008; Wilson et al. 2017; Pagano et al. 2018).

In summary, the magnitude of behavioral disturbance on the productivity of polar bears in the program area is likely to be minor, assuming that all required mitigative measures are implemented, as required under the current ITRs and specified in typical wildlife interaction plans for industrial activity in Arctic Alaska, and that preconstruction den surveys successfully detect most maternal dens in the affected areas. The number of bears affected is likely to increase during the operational life of program-related development as summer sea-ice cover continues to diminish in the future, resulting in more bears being present onshore during the open-water period, traveling the coastline more in summer and fall, and denning onshore. Such an increase is to expected as a result of the current trends for increasing use of coastal habitats and terrestrial denning habitats (Fischbach et al. 2007; Schliebe et al. 2008; USFWS 2006, 2008, 2009; Olson et al. 2017; Wilson et al. 2017). It is likely that maternal denning will continue to increase in terrestrial habitats in the future, although the presence of operating facilities would probably discourage female bears from denning in suitable habitat nearby; instead, they would be more likely to seek suitable den sites in less-disturbed areas, as suggested by Amstrup (1993).

Another source of potential disturbance of polar bears during all phases of exploration and potential development would be noise and light generated by industrial facilities such as CPFs. Noise from production facilities would be relatively constant, with wind direction affecting the perception of sounds by polar bears.

SEALS

Noise and disturbance from Program-related facilities and activities are likely to affect ringed seals annually throughout the period when they are present in the program area (March–November). A

primary source of potential disturbance of ringed seals would be noise generated by a seawater treatment plant (STP) located on the coast. That noise would be relatively constant, with wind direction affecting the perception of sounds at haul-out locations and in lairs within a maximum radius of 2.5–3.73 mifrom the STP. Other species of seals would be unlikely to range close enough to shore to be affected by noise from the STP. Additional noise could be generated by dredging or screeding and vessel traffic during barging operations in summer, mobilization of modular units in winter, and oil-spill drills year-round.

Although marine mammals show overt reactions to noise from industrial activities, individuals or groups may become habituated if the noise does not result in physical injury, discomfort, or social stress (NRC 2003). Based on habituation reported for ringed seals at the Northstar Island facility (Blackwell et al. 2004), it is likely that at least some ringed seals may habituate to the noise and continue to use haul-outs and lairs for pupping near the STP location, but that cannot be predicted with confidence. The effects of disturbance on ringed seals are predicted to be minor in magnitude and short term in duration (less than 5 years), with no demographic effects expected.

<u>Injury and Mortality</u>

Small numbers of accidental injury or mortality of marine mammals may occur under all of the action alternatives. Polar bears could be susceptible to vehicle strikes and other marine mammals to vessel/equipment strikes during barging and in-water work. Additional injury or mortality of marine mammals may occur due to accidental spills or contamination. For polar bears, program-related actions are most likely result in injury or mortality due to human–bear interactions. Potential injury or mortality of marine mammals due to collisions was evaluated qualitatively. Assessment was based on documented species behavior, sensitivity to the activity, mobility, and distribution relative to the frequency and seasonality of vehicle and vessel traffic.

POLAR BEAR

Construction activities under all alternatives would increase the level of human-polar bear interactions. Human activities could increase the potential for polar bears to become food conditioned, potentially resulting in the need to kill bears in defense of life and property. Sightings of polar bears at industrial sites in the Beaufort Sea region of Alaska have increased in recent years, consistent with increasing use of coastal habitats as summer sea-ice cover has diminished (Schliebe et al. 2008; USFWS 2008), and hazing incidents have increased accordingly. The majority of polar bear mortalities resulting from conflicts with humans in the Northwest Territories occurred during the ice-free period from August to November; most of the animals killed were subadult males (Stenhouse et al. 1988). As sea-ice cover continues to diminish in the future, the number of encounters between nutritionally stressed bears and humans is expected to increase (DeBruyn et al. 2010), which is cause for concern because of a small number of incidents in which malnourished polar bears killed and consumed humans at several incidents at industrial sites in the Beaufort Sea in the 1970s and at the village of Point Lay in 1990 (Truett 1993; Obbard et al. 2010).

When the polar bear was listed as a threatened species in 2008 (73 FR 28212), the USFWS noted that the factors contributing to the primary threat identified in the listing analysis—rapidly diminishing sea-ice habitat—cannot realistically be regulated under their management purview. Therefore, in lieu of influencing the causes underlying climate change, such as greenhouse gas emissions, USFWS has focused on factors more amenable to regulation, such as habitat protection and the prevention and reduction of

lethal take; the result of this approach is that even greater emphasis has been devoted to mitigation through interaction planning to avoid and minimize injury and mortality of polar bears (USFWS 2016regeh).

Despite increased interactions in the existing oilfields in recent years, virtually no lethal take or injuries of polar bears has been reported (USFWS 2008, 2009). Two polar bears have been killed in defense of human life at oil and gas industrial sites in Alaska since the late 1960s—one in winter 1968–69 and another in 1990 at the Stinson exploration site in western Camden Bay, north of the program area (Perham 2005; USFWS 2006), and one bear was killed (accidentally during hazing) since the Chukchi Sea and Beaufort Sea ITRs went into effect in 1991 and 1993, respectively (USFWS 2008, 2009). Several other mortalities have been associated with military and industrial activity. A polar bear was killed at the Oliktok Point Long-range Radar Site in 1993 (USFWS 2010) after it entered a building to attack a worker who had provoked it. A radio-collared polar bear died on Leavitt Island, 5 mi northwest of Oliktok Point, after ingesting ethylene glycol in a substance used for road and runway marking (Amstrup et al. 1989). In contrast, 33 polar bears were killed at industrial sites in the Northwest Territories during 1976–1986 (Stenhouse et al. 1988). Dyck (2006) reported that 618 polar bears (averaging 20 per year) were killed during 1970–2000 in the Northwest Territories and Nunavut in northern Canada, 25 (4 percent) of which occurred at industrial sites.

Upon issuance of an LOA by the USFWS, trained personnel have authority under Section 112(c) of the MMPA to haze or otherwise take polar bears under specific circumstances involving the protection of human life. In addition, USFWS has issued voluntary deterrence guidelines (75 FR 61631) to deter polar bears without serious injury or death. The deterrence guidelines include two levels: (1) passive measures intended to prevent polar bears from gaining access to property or people (fencing, gates, skirting, exclusion cages, bear-proof garbage containers), and (2) preventive measures intended to discourage bears from interactions with property or people (acoustic devices for auditory disturbance, vehicle or boat deterrence).

In addition to attraction to areas of human activity and direct interaction with humans, a second potential source of injury or mortality is premature den abandonment, which is a possible outcome of den disturbance and has been documented as an adverse effect on cub survival (Amstrup and Gardner 1994; USFWS 2008, 2009). The precautions against den disturbance in the interaction plan required under the ITRs and the denning surveys conducted before seismic exploration and construction of roads and pads would minimize the likelihood of this potential risk.

A third potential source of injury or mortality is traffic on ice and gravel roads that intersect the movement paths taken by females with young moving from terrestrial denning habitat to hunting areas offshore in late winter (March–April), posing a risk of vehicle strikes and disturbance-related distributional shifts. This risk notwithstanding, no vehicle strikes along similar ice roads have been reported in agency documents evaluating impacts on polar bears, indicating the impact is negligible.

A fourth potential source of injury or mortality is accidental spills, leaks, and other sources of contamination. The probability, volume, and potential spread of different types of spills are summarized elsewhere in this document. Polar bears are susceptible to thermal stress through fouling of their fur by direct contact with spilled petroleum products, which reduces body temperature and increases metabolic rate; oil is absorbed through skin contact, through the gastrointestinal tract, and by inhalation (Engelhardt 1983). Contact and ingestion can lead to severe blood and kidney problems. The direct and

indirect effects of spills depend primarily on the seasonal timing and location of the spills and on the volume of material released into the environment. Terrestrial spills during winter would have substantially less impact on polar bears than would marine spills during the open-water period in summer and fall. The only substantial program-related activity occurring in the marine environment would be barging of modules in several years during the open-water period, which would pose a minor risk of spilled fuel if a vessel carrying fuel were to run aground. The number of bears potentially affected by such an accident would be smaller than the numbers that would be affected by the hypothetical large marine spills modeled by Amstrup et al. (2006b), because the spill volume and the area affected would be substantially smaller.

Spills associated with development projects located on the mainland are of much less concern for polar bears than are marine spills. Although the risk of a large spill during the drilling, construction, and operational phases of the proposed program is very low, it cannot be ruled out. The volume of material released and the area affected would likely be small due to the volumes of material being used, the terrestrial base of activities. Small releases of contaminants also can have effects, however; Amstrup et al. (1989) documented the death of a polar bear following ingestion of ethylene glycol in a substance used for road and runway marking. Effective control of potentially toxic substances and careful attention to preventing spills of any size are the key to preventing such injuries. Overall, oil spills, leaks, and contaminant releases likely would pose negligible to minor effects on polar bears and their habitat in the program area, in view of the safeguards specified in the required spill prevention and contingency plan, the relatively small amounts of material likely to be released under most scenarios, and the ability to detect and clean up spills quickly on land, where most program-related activities would occur.

Any injury or mortality would pose a problem because of the declining status of the SBS population and the fact that human-caused mortality (from hunting, not industrial activity) approaches the potential biological removal for the stock (USFWS 2010). The attraction of polar bears to facilities and attendant problems may increase through the operational life of the proposed program as more bears become stranded onshore during the open-water season due to declining sea ice, leading to increased use of coastal travel routes past oil and gas facilities.

In summary, although the potential for injury or mortality could be high when developing new projects in polar bear habitat, the risks are well understood and effective mitigation is available, as is spelled out in the interaction plan required by the ITR/LOA process. Therefore, with this mitigation in place, the net effects of program-related activities are likely to be negligible in terms of injury and mortality at the population scale. Given the current and predicted continuing decline of the SBS stock of polar bears, emphasis will be placed on avoiding injury or mortality, and current mitigation measures appear to be effective at reducing such risks.

Whales and Seals

Any vessels operating in or along transportation corridors to the program area would follow specified procedures for changing vessel speed and direction to avoid collisions with marine mammals. Timing restrictions on barging activity would avoid adverse effects on newborn ringed seal pups, particularly when nursing and molting (NMFS 2016), because program-related vessel traffic would occur late in the open-water season when pups would be larger.

The number and speed of ships is related directly to the severity of collisions between vessels and whales (Jensen and Silber 2004). In contrast, seals are less likely than whales to be struck due to their smaller size and higher maneuverability. BOEM that estimated 67 vessels per year could transit the Beaufort Sea associated with oil and gas leasing and exploration (NMFS 2013). Collisions with whales are rare for slow-moving vessels traveling at less than 10 knots (Laist et al. 2001; Vanderlaan et al. 2008). Barge convoys would move slowly, but the vessels would be unable to change direction or speed quickly. Although it is possible that a marine mammal could be struck by a vessel engaged in the barging operation, such incidents are highly unlikely due to the slow vessel speed and low frequency of barge deliveries (assumed to be two landings per year).

The low incidence of propeller scars found on bowhead whales landed by Alaska Native whalers indicates that vessel strikes of bowhead whales are rare (George et al. 1994; Laist et al. 2001). There is no indication that vessel strikes would be a major source of mortality for whales during marine transport to the program area (NMFS 2013). Data recorded by Protected Species Observers aboard sound-source and monitoring vessels indicate that ringed and bearded seals in the Beaufort Sea avoid oncoming vessels (NMFS 2016) and there is no indication that vessel strikes would become an important source of injury or mortality (NMFS 2013).

The presence and movement of ships may cause some ringed and bearded seals to abandon preferred feeding and resting habitat in areas of high traffic. Ice-breakers have been known to kill seals when ice-breaking occurs in breeding areas (NMFS 2013). Interactions with whales and seals would be reduced somewhat by the seasonal timing of barge transport in mid- to late summer, a time when ringed and bearded seals also tend to occur farther offshore, and when most bowhead and beluga whales are foraging father east or northeast of the analysis area. Exposure to vessels during the open-water period may affect individual seals and whales, but evidence of habituation to activity and evasion of vessels indicates that activities associated with marine transport to the program area are not likely to affect the reproductive success or survival of seals and whales.

Another potential source of injury or mortality is accidental spills, leaks, and other sources of contamination. All of the exploration and development would occur on land, with oil being transported in terrestrial pipelines to TAPS. The potential effects of oil spills in the coastal zones of the program area related to marine transportation activity would be negligible due to the small number of vessel landings anticipated, safeguards in place to avoid and minimize oil spills, and generally limited amounts of oil aboard the vessels.

<u>Attraction to Human Activity and Facilities</u>

Other than polar bears, marine mammals are not likely to be attracted to program-related activities or facilities. Polar bears are curious and opportunistic hunters, frequently approaching and investigating locations where human activity occurs (Stirling 1988; Truett 1993). Proximity to humans poses risks of injury and mortality for both bears and humans and may necessitate nonlethal take through deterrence and hazing or, on rare occasions, lethal take to defend human life (Stenhouse et al. 1988; Truett 1993, Perham 2005). Stirling (1988) reported that curious polar bears commonly approached offshore drilling rigs in the Canadian Beaufort Sea whenever sea ice moved into the area but did not remain nearby for long unless seals were present in the leads created by the rigs. Sightings of polar bears at industrial sites in the Beaufort Sea region of Alaska have increased in recent years, consistent with increasing use of coastal habitats as summer sea-ice cover has diminished (Schliebe et al. 2008; USFWS 2008), and this

trend is likely to continue. Encounters between polar bears and humans in the program area are most likely to occur on and near the coastline as bears move through in late summer and fall (August–October) and as maternal females with young cubs depart from terrestrial dens in late winter (March–April); the latter animals are the least likely to be attracted to industrial facilities, however, due to their greater sensitivity to disturbance.

The current ITR/LOA process has proven to be effective at addressing and mitigating the risks of polar bear encounters with humans. Besides denning surveys, the interaction plan required by the ITRs stipulates monitoring and reporting of bear sightings and encounters using trained observers, as well as training of personnel in nonlethal means of protection (deterrence and hazing). Although camps and other activity areas have the potential to attract polar bears, experience demonstrates that these risks can be mitigated effectively by following the interaction plan; for example, with detection systems using bear monitors, motion/infrared sensors, and adequate lighting; safety gates, fences, and cages for workers, as well as skirting of elevated buildings; careful waste handling and snow management; chain-of-command procedures to coordinate responses to sightings; and employee education and training programs (Truett 1993; Perham 2005; USFWS 2006, 2008, 2009). All Program-related activities must be conducted to minimize the attractiveness of work and facility sites to polar bears and to prevent their access to food, garbage, putrescible waste, and other potentially edible or harmful materials, as required by ROPs 1–3 and 5 in **Chapter 2**. Trained bear monitors would be present on site and all polar bear sightings would be reported immediately to safety personnel.

Alternative B

The types of program-related activities and facilities would be similar among the action alternatives, as described above in **Chapter 2**, but the location and extent of infrastructure and associated activity would differ among alternatives, in accordance with stipulations and ROPs. Differences that would alter effects on marine mammals among alternatives primarily include differences in the distribution and acreage of potential denning habitat for maternal polar bears, as well as the extent to which activities and facilities would be permitted in coastal habitats used as travel routes by polar bears. The impacts among action alternatives cannot be quantified accurately without knowing the future locations of program-related activities and facilities, so this evaluation assesses impacts by comparing the number of dens, amount of potential maternal denning habitat mapped, and likelihood of use by polar bears of the areas subject to various lease types and stipulations.

Under Alternative B, the entire program area is available to lease for oil and gas activity. As a result, this alternative presents the greatest difference from Alternative A by enabling program activities and facilities in nearly all potential terrestrial maternal denning habitat within the program area. Despite the lack of specific protection of denning habitat under this alternative, however, Stipulation 1 (Rivers and Streams) would protect some potential maternal denning habitat by prohibiting permanent facilities within 0.5–1 mi of the 8 rivers listed under that stipulation. The area in which surface occupancy would not be allowed under Stipulation 1 includes 38 percent of the known polar bear dens (**Table 3.3.6-3**) and 21 percent of the potential maternal denning habitat mapped in the Program Area (**Table 3.3.6-4**).

Table 3.3.6-3

Number and Percentage of Documented Polar Bear Dens by Alternative, Hydrocarbon Potential, and Lease Type.

Lease Type	Alternative B				Alternative C				Alternative D (identical for D1 and D2)			
Hydrocarbon Potential:	**High**	**Medium**	**Low**	**Total**	**High**	**Medium**	**Low**	**Total**	**High**	**Medium**	**Low**	**Total**
No Sale	–	–	–	0	–	1	2	3	–	2	2	4
						5%	100%	6%		10%	100%	9%
No Surface Occupancy	15	2	1	18	18	7	–	25	23	16	–	39
	60%	10%	50%	38%	72%	35%		53%	92%	80%		83%
Controlled Surface Use	–	–	–	0	–	–	–	0	–	1	–	1
										5%		2%
Timing Limitations	3	10	1	14	3	7	–	10	–	–	–	0
	12%	50%	50%	30%	12%	35%		21%				
Standard Terms and Conditions	7	8	–	15	4	5	–	9	2	1	–	3
	28%	40%		32%	16%	25%		19%	8%	5%		6%
Grand Total	25	20	2	47	25	20	2	47	25	20	2	47

Table 3.3.6-4

Estimated Acreage of Potential Maternal Denning Habitat by Alternative, Hydrocarbon Potential, and Lease Type.

Lease Type	Alternative B				Alternative C				Alternative D1				Alternative D2			
Hydrocarbon Potential:	**High**	**Med.**	**Low**	**Total**	**High**	**Med.**	**Low**	**Total**	**High**	**Med.**	**Low**	**Total**	**High**	**Med.**	**Low**	**Total**
No Sale	–	–	–	0	–	600	1,700	2,300	100	700	2,000	2,800	100	700	2,000	2,800
						14%	74%	24%	3%	16%	80%	28%	3%	16%	80%	28%
No Surface Occupancy	700	700	600	2,000	1,000	1,300	200	2,500	1,700	3,000	400	5,100	1,700	3,000	400	5,100
	26%	16%	25%	21%	37%	30%	9%	27%	59%	67%	16%	52%	59%	67%	16%	52%
Controlled Surface Use	–	–	–	0	–	–	–	0	300	400	100	800	300	400	100	800
									10%	9%	4%	8%	10%	9%	4%	8%
Timing Limitations	600	2,600	1,800	5,000	600	1,700	400	2,700	–	–	–	0	800	400	–	1,200
	22%	60%	75%	53%	22%	39%	17%	29%					28%	9%		12%
Standard Terms and Conditions	1,400	1,000	–	2,400	1,100	800	–	1,900	800	400	–	1,200	–	–	–	0
	52%	23%		26%	41%	18%		20%	28%	9%		12%				
Grand Total	2,700	4,300	2,400	9,400	2,700	4,400	2,300	9,400	2,900	4,500	2,500	9,900	2,900	4,500	2,500	9,900

Except for those river buffers, all program activities and facilities would be allowed throughout the areas of greatest proportional occurrence of dens (high and medium HCP zones), relying on adherence to ITRs and requiring surveys to detect occupied dens before beginning winter activities. Under Alternative B, Stipulations 2 (Canning River delta/lakes), 3 (springs/aufeis), 4 (coastal and marine habitats), and 5 (polar bear denning habitat) contain no specific requirements relevant to polar bears or their habitat, resulting in greater long-term disturbance effects than under Alternative A and the greatest among the action alternatives because of the larger area open to leasing under this alternative.

The coastline survey required under Stipulation 9 for this alternative would provide some specific information for planning purposes but would not specifically restrict activities that would disturb polar bears using coastal habitats, leaving the regulatory requirements of the ITRs/LOAs as the sole mitigation measures in effect in the coastal area to reduce disturbance of bears moving along and denning near the sea coast, including the barrier islands unit of designated critical habitat and its attendant 1 mi no-disturbance zone.

ROPs 1–3 (waste disposal, waste management, and hazmat/contingency planning) and adherence to the requirements of the current ITRs would reduce the potential for attraction to improperly handled garbage and other putrescible waste, greatly diminishing the safety risks that could result from habituation and food-conditioning of polar bears. ROP 5 (bear interaction plans) would reduce the safety risks for both humans and bears by ensuring that plans are in place to address the risks of, and solutions for, bear-related problems and to follow accepted practices for hazing bears around facilities, when necessary. Because the highest number of documented polar bear dens and the greatest area of potential maternal denning habitat occur in the high and medium-potential hydrocarbon zones where the least restrictive development activities would be most likely to occur, the potential impacts of waste handling and bear–human interactions under this alternative would be the most different from Alternative A and would be greater than those under the other two action alternatives.

Under ROP 11 (see **Chapter 2**), the pre-activity surveys for dens and the 0.5-mile and 1-mile buffers for seismic and heavy equipment operation around occupied dens of grizzly and polar bears, respectively, would help to reduce the impacts of behavioral disturbance on denning bears (as well as birth lairs of ringed seals on landfast ice off the coast) throughout the entire program area. Even so, complete detection of occupied bear dens is unlikely to be achieved, so an unknown (though probably small) number of denning bears could be disturbed by such operations every winter during exploration, construction, and development drilling phases, which would reach the highest levels under this alternative in comparison to Alternative A.

The requirement to obtain permits before installing fences to capture snow under ROP 16 (identical among all three action alternatives; see **Chapter 2**) would alleviate potential conflicts with denning bears. Pregnant polar bears could be attracted early in the denning season to the drifts in the lee of snow fences, which could create suitable denning habitat if the drifts became deep enough.

Alternative C

The 30 percent of the program area that would be unavailable for leasing under Alternative C contains 24 percent of the potential maternal denning habitat, but only 6 percent of the known dens in the program area (**Tables 3.3.6-3 and 3.3.6-4**). Most of the dens that have been found in the program area occur in the zones of high and medium hydrocarbon potential where leasing would be allowed,

most of which would be open to development under standard terms and conditions or under NSO stipulations.

The NSO area under Alternative C, Stipulations 1 (rivers/streams) and 9 (coastal area), would include 53 percent of the known maternal dens and 27 percent of potential denning habitat (**Tables 3.3.6-3 and 3.3.6-4**). The NSO buffer within 1 mile of the coastline, barrier islands, and lagoons under Stipulation 9 (coastal area) would reduce potential disturbance of polar bears moving through those habitats during all seasons and denning there in winter, and thus would be consistent with the 1-mile no-disturbance zone that is required around the barrier islands/coastal spits unit of critical habitat designated for the species. Under Alternative C, Stipulations 2 (Canning River delta/lakes), 3 (springs/*aufeis*), 4 (coastal and marine habitats), and 5 (polar bear denning habitat) contain no specific requirements relevant to polar bears or their habitat, resulting in greater long-term disturbance effects on the species than under Alternative A and similar effects as under Alternative B in those areas.

The area subject to timing limits under Alternative C would include an additional 21 percent of known dens and 29 percent of potential denning habitat (**Tables 3.3.6-3 and 3.3.6-4**), but those timing limits are intended primarily as mitigation for caribou post-calving habitat during summer and thus would not benefit maternal polar bears during winter in the area subject to those limits. Therefore, long-term disturbance impacts likely would be greater than those under Alternative A and similar to those under Alternative B in the portions of the program area open to leasing.

The requirements of ROPs 1–3 (waste disposal, waste management, and hazmat/contingency planning) and 5 (bear interaction plans) under this alternative would be identical to those under Alternative B, but the potential impacts would be less under this alternative because the area open to leasing would be 30 percent smaller than under Alternative B.

The requirement of ROP 11 (bear den buffers) would be identical to that under Alternative B, but the area subjected to disturbance by seismic and heavy equipment operation would be smaller, restricted to the 70 percent of the program area that would open to leasing under Alternative C. Similarly, the area subject to ROP 16 would be smaller than under Alternative B.

Alternative D

Alternatives D1 and D2 would be identical with regard to potential impacts on polar bears, so they are discussed together here. By affording the highest degree of protective measures for polar bears, this alternative would be more similar to Alternative A in terms of potential impacts than would the other two action alternatives. As described below, the no-leasing area and NSO buffers under Alternative D (0.5–4 mi around 17 rivers, the Canning River delta/lakes, and three springs) would encompass 92 percent of known dens and 80 percent of potential denning habitat, affording the highest level of protection for polar bear denning among the action alternatives.

The 33 percent of the program area that would not be available for leasing under Alternative D contains 28 percent of the potential maternal denning habitat but only 9 percent of maternal dens (**Tables 3.3.63 and 3.3.6-4**), so has been used less for denning than would be expected on a proportional basis. In contrast, the various NSO areas under this alternative contain 52 percent of the potential denning habitat and 83 percent of the known dens (**Tables 3.3.6-3 and 3.3.6-4**), reducing the potential for

impacts from Program-related habitat loss and disturbance to the lowest degree among the action alternatives.

Under Stipulation 5, the “coastal polar ben denning river habitat” zone (see **Maps 2-6 Alternative D1, Individual Stipulations and 2-8 Alternative D2, Individual Stipulations** in **Appendix A**) subject to NSO and activity timing limits totals 106,500 acres, constituting 6.7 percent of the program area and 8.7 percent of the terrestrial denning unit of designated critical habitat in the program area. Despite being such a small percentage of that unit of critical habitat, the stipulated area within 5 mi of the coast and 1 mi of the Sadlerochit and Niguanak rivers and Katakturuk, Marsh, and Carter creeks encompassed 36 percent of the maternal dens documented in the entire program area in past years.

In addition to the specific protection of maternal denning habitat in that zone under Stipulation 5, Stipulations 1 and 2 (rivers/streams and Canning River delta/lakes, respectively) would protect potential denning habitat by prohibiting permanent facilities in NSO buffers within 0.5–1 mi of the 8 rivers listed for those two stipulations. Stipulation 3 (springs/*aufeis*) would protect denning habitat by excluding leasing and instituting a 3-mile NSO buffer around Sadlerochit Spring, Fish Hole 1 on the Hulahula River, Tamayariak Spring, and along the east bank of the Canning River.

The various stipulations restricting facilities and activities in coastal habitats would reduce behavioral disturbance of polar bears moving along the coastline throughout most of the year. Under Stipulation 5 (polar bear denning), timing limits would reduce disturbance of polar bears by prohibiting Program-related activities within 1-mi river buffers up to 5 mi inland between October 30 and April 15. In addition, the timing limits under Stipulations 4 (coastal/marine habitats) and 9 (coastal area) would reduce disturbance between May 15 and November 1 (or whenever sea ice comes within 10 mi of shore) by restricting program-related activities within a 2-mi coastal buffer.

ROPs 1–3 (waste disposal, waste management, and hazmat/contingency planning) and adherence to the requirements of the current ITRs would reduce the potential for attraction to improperly handled garbage and other putrescible waste, greatly diminishing the safety risks that could result from habituation and food-conditioning of polar bears. ROP 5 (bear interaction plans) would reduce the safety risks for both humans and bears by ensuring that plans are in place to address the risks of, and solutions for, bear-related problems and to follow accepted practices for hazing bears around facilities, when necessary.

Under ROP 11, the pre-activity surveys for dens and the 0.5-mi and 1-mi buffers for all oil and gas activity (not just seismic and heavy equipment operation, as under the other two action alternatives) around occupied dens of grizzly and polar bears, respectively, would reduce the impacts of behavioral disturbance on denning bears (as well as birth lairs of ringed seals on landfast ice) to the greatest degree among the action alternatives, most similar to Alternative A. The area subject to ROP 16 would be the smallest among the action alternatives, most similar to Alternative C.

Cumulative Impacts

Most existing industrial development along the Beaufort Sea coast has occurred in terrestrial habitats, which typically receive much less use by polar bears throughout the year than do marine habitats offshore. Over time, development began to expand into marine areas, however, starting with the construction of West Dock in the Prudhoe Bay field, and followed by the Endicott Project, the first

offshore production facility in the region, and the Northstar Project, located on artificial islands offshore from Prudhoe Bay. The Endicott and Northstar islands have recorded the highest incidences of polar bear sightings and nonlethal hazing incidents in recent years (USFWS 2009). Analysis of the cumulative effects of oil and gas leasing, exploration, development, and production by the NRC (2003 pg. 105) concluded that "industrial activity in the marine waters of the Beaufort Sea has been limited and sporadic and likely has not caused serious cumulative effects to ringed seals or polar bears." Nevertheless, expansion of oil and gas development along the arctic coast on both land and sea may reach a level at which such effects become problematic for polar bears in the future (Amstrup 2003a; USFWS 2009).

Large-scale climate change, existing oil and gas development, commercial transportation, subsistence harvest and changes in the activities of local communities, and management and research actions by federal and state agencies are the principal activities contributing to cumulative effects on polar bears and other marine mammals in Arctic Alaska. Tourism is growing in Kaktovik, with commercial enterprises offering viewing opportunities of polar bears and recreational travel in the Arctic Refuge.

Marine mammals are exposed to potentially toxic chemical compounds in the water and the food web that have been transported to the Arctic from around the world through the atmosphere, water currents, and migrating animals (AMAP 2010). As a top predator, polar bears tend to have higher levels of potentially toxic compounds that bioaccumulate in the food chain, such as organochlorines and mercury (Braune et al. 2005; AMAP 2010).

Onshore oil and gas production, such as that proposed in the program area, typically requires large sea lifts using barges to transport facility modules, equipment, and material from southern ports to docks on the Beaufort Sea coast. Onshore infrastructure also can affect marine mammals through the need for sea ice roads that cross ringed seal habitat in landfast ice, and ice and gravel infrastructure can affect polar bear habitat and maternal polar bear denning, as described above. These impacts of onshore production would likely affect polar bears through disturbance in coastal barrier-island and denning habitats, especially during construction, but would be mitigated through the ITRs and LOAs issued by the USFWS. The combined effects of likely future actions, particularly those located in the arctic marine environment, may contribute to adverse effects on the polar bear population in the future, primarily through expansion of coastal and offshore development and the increased risk of a major marine oil spill. Compared with climate change, however, the cumulative effects of industrial activities associated with oil and gas exploration, development, and production would be substantially lower in magnitude.

Climate change is a global issue affecting marine mammals in the program area. Climate warming is expected to be most dramatic in the Arctic, with rates of warming nearly twice that experienced globally (ACIA 2005; Wendler et al. 2014). The effects of these global trends are complicated, yet the forecast models—based on current trends—that have been constructed to examine the likely effects on marine mammal habitats point to dramatic declines in the extent and thickness of arctic sea-ice cover, which has serious implications for the future of species such as polar bears and ice seals (Durner et al. 2009; Cameron et al. 2010; Kelly et al. 2010; Regehr et al. 2016).

Climate change in the Arctic is a rapidly growing concern, especially for the marine environment. Increased air and sea temperatures, longer periods of open water with an earlier onset of melting and later onset of freeze-up, increased rain-on-snow events, warm water intrusion, and changing atmospheric wind patterns are contributing to overall reduction and changes in sea ice (Kovacs et al.

2011; Chapin et al. 2014). The greatest concern for marine mammals in the reasonably foreseeable future are continued Arctic warming trends and the resulting deterioration of sea ice conditions that are necessary for ice-dependent species and their prey. Arctic sea ice is changing in the extent of geographic coverage, thickness, age, and timing of melt, and is one of the most pronounced changes currently occurring, at rates higher than previously predicted. Analysis of long-term data sets show substantial decreases in both extent (area of ocean covered by ice) and thickness of sea ice cover during the past 30 years (Post et al. 2013;Wendler et al. 2014). These trends are projected to continue, possibly resulting in loss of summer sea ice by mid-century (Chapin et al. 2014) and suggesting that all ice-dependent species may experience conditions that could result in declines of food availability and foraging and breeding habitat. The ongoing declines in the extent and duration of sea-ice cover present the greatest source for possible population-level impacts on marine mammals over the next 20 years, although the impacts are not entirely clear. Bowhead whales appear to be in better body condition in years of light ice cover (George et al. 2006) and the Western Arctic stock is so far adapting to change in ice cover, as demonstrated by their consistent population increase (Muto et al. 2018). The broad distribution, diverse diet, and ability to haul out on land or ice suggest that ringed seals may be resilient to changes in sea ice availability (NMFS 2013). Bearded seals are more strongly associated with sea ice available over shallow benthic habitat that is suitable for feeding, suggesting they may be less resilient to reduced sea-ice cover (NMFS 2013).

Recent shifts in distribution and habitat use by polar bears and walrus in the Beaufort and Chukchi seas are likely attributable to loss of sea ice habitat. The greatest declines in optimal polar bear habitat are expected to occur in those areas, where reduced habitat will likely reduce polar bear populations (Durner et al. 2009; Regehr et al. 2016). The increased frequency with which female polar bears in the SBS population now den on land rather than on pack ice was attributed to reductions in stable old ice, increases in unconsolidated ice, and lengthening of the melt season (Fischbach et al. 2007; Olson et al. 2017). Another result of climate change is increasing delays in formation of sea ice in the fall, forcing more bears to spend more time on land where they have difficulty catching prey, spend longer periods fasting, and increasing the chance of interactions with humans, increasing the risk of mortality of bears killed in defense of life or property (Amstrup 2000; Whiteman et al. 2015). The warming temperatures and increased precipitation year-round and longer growing seasons that are predicted to occur in the future may have negative implications for the stable conditions required for maternal denning by polar bears, especially if warm temperatures prevent snow cover of sufficient depth from accumulating early in the denning season. Population-level effects of sea-ice loss have been observed in polar bears at the southern edge of their range in western Hudson Bay, and models predict decreased survival (including breeding rates and cub litter survival) of polar bears in the SBS population with reduced sea-ice coverage (Regehr et al. 2010; Hunter et al. 2011). Reduced body size and cub recruitment in polar bears have been documented in years when sea ice availability was reduced (Rode et al. 2010).

Range expansion of subarctic and temperate species into the Beaufort and Chukchi seas has been observed in recent years and is likely to continue with changing arctic conditions. Increased observations of gray whales, humpback whales and fin whales in the northeastern Chukchi Sea and gray and humpback whales in the western Beaufort Sea is a relatively recent phenomenon (Clarke et al. 2015). Thus far, potential range expansion into the Beaufort Sea has been limited, but sightings appear to be increasingly slowly. Range expansion by more temperate species raise the possibility of resource competition with arctic species (ACIA 2005). Other risks to arctic marine mammals induced by climate change include increased risk of infection and disease with improved growing conditions for disease

vectors and from contact with non-native species, increased pollution through increased precipitation transporting river borne pollution northward, and increased human activity through shipping and offshore development (ACIA 2005; Huntington 2009; Hauser et al. 2018).

3.4 Social Systems

3.4.1 Landownership and Use

Affected Environment

The affected environment for landownership and use is similar to Section 4.1.2, Land Status, in the Arctic National Wildlife Refuge CCP (USFWS 2015); however, because the Coastal Plain program area does not include the entire Arctic Refuge, a revised description of the program area is included here. Lands administered by the USFWS account for approximately 91 percent (1,423,800 acres) of the program area surface. Of the remaining surface area, 99 percent (138,700 acres) is water. Less than 1 percent (900 acres) are Alaska Native Allotments. Patented and allotment lands are mostly located along the Beaufort Sea between the Hulahula and Jago Rivers. There also are smaller, isolated allotments along the coast (see **Map 3-24, Landownership** in **Appendix A**). Descriptions of Alaska Native Lands and Allotments are incorporated here by reference from the USFWS CCP (USFWS 2015).

There are no BLM-administered surface lands in the program area; however, the BLM manages 1,426,900 acres of subsurface mineral estate (see **Sections 3.2.5**, Geology and Minerals, and **3.2.6**, Petroleum Resources). Although none currently exist, the BLM would manage federal oil and gas leases, permits, and ROWs associated with fluid mineral development.

With the exception of Barter Island, there are no roads, power lines, pipelines, or other permanent facilities or structures in the program area. On Barter Island are two, single runway airports and the city of Kaktovik, a community of approximately 250 people.

Direct and Indirect Impacts

Direct and indirect impacts on landownership and uses are the result of decisions that change landownership or from stipulations that allow or restrict certain land uses. Landownership decisions, such as conveyance or transfers, can increase or decrease the amount of federal land and the type of management available for those lands. Use restrictions, such as those intended to protect resources or to reduce conflicts with other uses, can preclude the placement of new infrastructure or require special conditions for development. In areas subject to NSO, new land uses would be precluded. Any new uses would be required to locate in areas outside of the NSO area. Depending on the use, developing the use outside of the NSO area may not be physically or commercially viable. In areas subject to CSU or TL, additional requirements, such as long-term monitoring, special design features, special siting requirements, and timing limitations could restrict project location or viability of projects.

Alternative A

Under Alternative A, there would be no federal minerals offered for future oil and gas lease sales in the program area and therefore no direct or indirect impacts on uses. There would be no change in landownership.

Impacts Common to All Action Alternatives

Under all action alternatives, areas would be made available for lease sales consistent with the Tax Act. Demand for petroleum resources would result in the subsequent development of oil and gas exploration and production well pads, CPFs, roads, pipelines, barge dock, a seawater treatment plant, and other ancillary uses to support oil and gas development. While the location of these uses would vary under the action alternatives, as discussed below, the size, type, and amount would be nearly the same.

New oil and gas development in the program area would indirectly affect land uses within and surrounding the community of Kaktovik. As one of the North Slope's larger communities and the main point of arrival and departure for air travel to the program area, new or expanded residential, commercial, industrial, and civic land uses would be expected, especially over the long term. Areas south of Kaktovik's current development footprint mare likely to experience the most notable growth (North Slope Borough 2015).

There would be no change in landownership under any of the action alternatives

Alternative B

The nature and types of impacts on land uses under Alternative B would be the same as those described under Impacts Common to All Action Alternatives. Making the entire program area available for lease sale and applying NSO stipulations to only 17 percent of the lands available for leasing would allow land uses to be developed in most areas. Areas subject to NSO where uses would be precluded would largely be along river corridors.

Alternative C

Under Alternative C, the nature and types of impacts on land uses would be the same as those described under Impacts Common to All Action Alternatives and similar to Alternative B. However, making 476,600 acres unavailable for lease sales and an additional 389,800 acres subject to NSO stipulations, would limit the locations where new uses could be developed to 697,100 acres (45 percent) of the program area. These areas would be subject to timing limitations or CSU stipulations which would influence the design, location, and extent of seasonal use associated with the use.

Alternative D

Under Alternative D, the nature and types of impacts on land uses would be the same as those described under Impacts Common to All Action Alternatives and similar to Alternative C. Making 526,300 acres unavailable for lease sales and an additional 708,600 acres subject to NSO stipulations, would limit the locations where new uses could be developed to the remining 340,500 acres (21 percent) of the program area. These areas would be subject to timing limitations or CSU stipulations which would result in the same types of effects as those described under Alternative C and in the nature and types of effects discussion, above.

Cumulative Impacts

Cumulative impacts on landownership and uses would be the result of a change in the demand for lands to be transferred out of federal ownership to support a public use or demand for land uses associated with energy or mineral development. Past, present, and reasonably foreseeable future actions described in **Appendix M**, Approach to the Environmental Analysis, that would cumulatively impact land

ownership and uses include future oil and gas exploration and production and associated demand for infrastructure, and community expansion, particularly near Kaktovik, with associated demand for land uses and potential land tenure actions.

Under all action alternatives, new oil and gas exploration and development activity would increase the number and density of uses in the program area. Applications for uses would be processed on a case-by-case basis, subject to stipulations and other protective measures. NSO stipulations, particularly under Alternatives C and D could result in the concentration of new uses in smaller areas. As new oil and gas uses are developed in an area, the availability of those public lands for other oil and gas infrastructure would decline. Collocation or use of shared facilities would alleviate this impact.

Expanding interest in the program area would influence uses in nearby Kaktovik. Combined with past, present, and future actions, which include plans to expand community infrastructure and transportation facilities in the city, new oil and gas development could increase demand for new residential, commercial, civic, and industrial lands uses in the city. Because Kaktovik's urban footprint is confined by the Beaufort Sea to the north, east, and west and public lands to the south, there may be future interest in conveying lands out of federal ownership to accommodate new community development.

3.4.2 Cultural Resources

Affected Environment

This section incorporates information from the following sources: Alaska Department of Natural Resources, Office of History and Archaeology (ADNR OHA 2018) Alaska Heritage Resources Survey (AHRS);[20] North Slope Borough's Traditional Land Use Inventory (TLUI) (IHLC 2018);[21] ADNR, Division of Mining, Land and Water (ADNR MLW 2018) RS 2477 trail database (e.g., historic public rights-of-way; the National Oceanic and Atmospheric Administration, Office of Coast Survey (NOAA OCS 2016) wrecks and obstruction database; and previous literature and EIS documents near the program area, including the Point Thomson EIS (USACE 2012) and Arctic Refuge Revised Comprehensive Conservation Plan EIS (USFWS 2015). The BLM also reviewed scoping testimony for this EIS for information on cultural resources in the program area.

The relevant regulations for evaluating the effects on cultural resources are NEPA and Section 106 of National Historic Preservation Act (NHPA) and its implementing regulations in 36 CFR 800. Federal agencies are encouraged to coordinate compliance with Section 106 with any steps taken to meet the requirements of NEPA and should consider their Section 106 responsibilities as early as possible in the NEPA process (36 CFR 800.8a). Other relevant legislation that applies to the management of cultural resources are such legislation as the Antiquities Act of 1906 (16 USC 431 et seq.); the Archaeological Resources Protection Act (ARPA) of 1979 (16 USC 470 et seq.); the Abandoned Shipwreck Act of 1987 (PL 100-298); the American Indian Religious Freedom Act (AIRFA); Section 4(f) of the DOT Act (49 USC 303); the Archaeological and Historic Preservation Act of 1974 (the Moss-Bennett Act); Executive Order 13007 (Indian Sacred Sites); and the Native American Graves Protection and Repatriation Act (NAGPRA; 25 USC 3001-3013).

[20] AHRS data reviewed for this EIS in June of 2018

[21] BLM requested TLUI data from IHLC in March 2018 and as of June 2018 the data had not been received. The TLUI data will be incorporated once received from IHLC.

Cultural and Historic Context

The Arctic National Wildlife Refuge (Arctic Refuge) Revised Comprehensive Conservation Plan (CCP) EIS (USFWS 2015) and Point Thomson EIS (USACE 2012) describe the prehistory and history of the Arctic Refuge, including the program area. **Table 3.4.2-1**, below, provides a summary of the prehistoric context as presented in the CCP (USFWS 2015). **Table 3.4.2-2** is a summary of the historic themes occurring near the program area, based on USACE 2012. **Section 3.4.4**, Sociocultural Systems, also provides a historic overview of the Iñupiat and Gwich'in people that is relevant to this section.

Table 3.4.2-1
Prehistoric Traditions of the Arctic Refuge Area

Tradition	Period
Paleoindian	13,700 to 9,800 years ago
American Paleo-Arctic	11,800 to 8,000 years ago
Northern Archaic	8,000 to 3,000 years ago
Arctic Small Tool Tradition	5,000 to 2,400 years ago
Birnirk Culture	1,600 to 1,000 years ago
Thule	1,000 to 400 years ago
Iñupiat	400 years ago to present
Athabascan	2,000 years ago to present

Table 3.4.2-2
Historic Themes near the Program Area

Theme	Period
Euro-American exploration	1820s to 1880s
Early ethnographic research	1900s to 1920s
Trading posts and reindeer herding	1920s to 1940s
Military presence/DEW Line sites	1950s to 1980s
Land conservation	1950s to present
Oil development	1970s to present

Cultural Resources in the Program Area

<u>Previous Surveys</u>

In general, previous surveys to identify cultural resources in the program area have been concentrated primarily along the coastal region, with fewer investigations along the river systems and little research in the overland areas. A review of the previous surveys module of the AHRS database, using section-level[22] spatial coverage for the program area, returned 23 records, consisting of 10 literature reviews, 12 reconnaissance surveys, and 1 intensive survey. A similar review of the document repository module of the AHRS returned 30 records for reports associated with those sections.

Past surveys have largely been concentrated in and around the village of Kaktovik, along the coast and barrier islands of the Beaufort Sea, and along several of the major rivers in the area. Of special note is one wide-area survey of the program area conducted by Edwin Hall (1982) over approximately 20 days, using aerial overflights and limited pedestrian investigation of the coastal area and select river systems.

[22] The finest resolution of the AHRS database for wide-area queries is the section level, which may result in non-project area lands being included in the search.

This survey represents the only attempt at systematic coverage of the program area guided by targeted surveys at high potential landforms and topographic settings. Overall, vast inland areas of the program area have received little to no systematic investigation for cultural resources; while the coastal region has been the subject of a greater number of survey efforts, dynamic coastal erosion processes are affecting those resources.

Previously Documented Sites

For the Arctic Refuge, the USFWS (2015) identified several categories of site types that could be found. These types are as follows for the five categories most likely to be found in the program area, which correspond to the specific sites identified in the program area:

- Coastal settlements, consisting of semi-subterranean driftwood or whalebone houses, in some cases associated with cemeteries or additional structures. Post-contact and pre-contact houses are present along the coast of the Beaufort Sea.
- Inland settlements, consisting of semi-subterranean driftwood or whalebone houses, also in some cases associated with cemeteries or additional structures. This is the least known type of site on the Arctic Refuge.
- Tent ring complexes, consisting of arrangements of stones used to secure skin tents to the ground, often with associated hearths in and outside the ring. These features are found along river corridors on elevated terraces and likely relate to seasonal caribou hunting by coastal people. In some cases, these complexes are near or next to caribou drive lines or fences.
- Lithic scatters, consisting of surface and subsurface collections of artifacts and debris resulting from the procurement, preparation, and manufacture of stone tools. In many cases, lithic typological and technological comparisons are the only way of assigning an age to a site.
- Historic cabins built by indigenous peoples, early explorers, and trappers that offer insights into the early contact period.

There are 90 AHRS sites recorded in the program area, including sites of both prehistoric and historic origin (**Table 3.4.2-3**). Approximately one-third of the sites have prehistoric components, including such features as sod houses, lithic scatters, tent rings, and various artifact scatters. Historic sites comprise the remaining two-thirds of sites and include military sites associated with the DEW Line and several historic Iñupiaq structures, such as sod houses, cellars, tent frames, and other buildings.

[*TLUI PLACEHOLDER – BLM Reviewers*: waiting on TLUI data sharing; placeholders are highlighted below where data will be inserted to the text when received]

Other repositories of cultural resources are the Revised Statute (RS) 2477 database and the NOAA Wrecks and Obstruction database. The RS 2477 trail database identifies three RS trails (914, 1043, 1649) in the program area. RS 914 is the Poker (Pokok) Lagoon Southeast Trail, a 5.5-mile winter trail near Pokok Lagoon; RS 1043 is the Bullen-Staines River Trail, a 22-mile tractor trail; and RS 1649 is the Tamayariak River-Simpson Cove Trail, a 20-mile tractor trail. The NOAA database identifies two shipwrecks in the program area, one just off the northeast shoreline of Barter Island and a second in Camden Bay next to the POW-D DEW Line site.

Table 3.4.2-3
Documented AHRS Sites in Program Area

AHRS #	Site Name	Period	Resource Description
BRL-00004	Igluqpaaluk	Historic	Residence, sod house, ice cellar, trading post
BRL-00005	Uqsruqtalik	Historic	Camp, hunting, sod houses, cabins, ice cellars
BRL-00007	Naalagiagvik	Prehistoric, Historic, Protohistoric	Settlement, sod houses, burials
BRL-00009		Historic	Burials
BRL-00012		Historic	Residential, cabin, log, sod house
BRL-00017	Uqsruqtalik	Historic	Burials
BRL-00018	Kapiluuraq	Historic	Camp, fishing, sod house
BRL-00020		Historic	Residential, sod house
BRL-00022	Puukak	Historic	Camp, sod houses, cemetery
BRL-00023	(Doe) BAR-M (AHRS) Barter Island	Historic	Defense, DEW Line
BRL-00044	Gravel structures, Barter Island Airfield	Historic	Defense, DEW Line, transportation
BRL-00051	Barter Island seawall	Historic	Military, seawall, defense, DEW Line
BRL-00052	Browers Camp	Historic, Modern	Camp, tent floors, drying racks, windbreaks
XDP-00001	Angun	Historic	Sod house ruins, foundations
XDP-00021		Historic	
XDP-00022		Historic	
XDP-00024	Atchalik	Historic	Sod house ruins, sod quarry, cache pots
XDP-00026		Historic	Burials
XDP-00027		Historic	Sod house ruins, sod quarry
XDP-00028		Historic	Burials, box coffins
XDP-00029		Historic	
XDP-00030		Historic	
XDP-00031		Prehistoric	Lithic scatter
XDP-00032		Prehistoric	
XDP-00033		Historic	
XDP-00034		Historic	
XDP-00035		Prehistoric	
XDP-00045	Beaufort Lagoon (AHRS) Demarcation Point	Historic	Defense, DEW Line
XDP-00046	Nuvagapak Jacobson and Wentworth's TLUI Site 32		
XDP-00048	Nuvagapak reburial	Historic	Reburied human remains
XFI-00003	Anderson Point	Prehistoric	Settlement, bone and wood artifacts
XFI-00009	Brownlow Point, Agliguagruk	Historic	House ruins, burials
XFI-00011	Sanniqsaaluk	Historic	Cabin, ice cellar, camp
XFI-00013		Historic	Ice cellar
XFI-00014		Historic	Lookout tower
XFI-00015		Historic	Single dwelling, sod house
XFI-00016		Historic	Settlement, sod houses, sod quarry
XFI-00017	Kanigniivik	Historic	Burials
XFI-00018		Historic	Single dwelling, sod house, artifacts
XFI-00019		Historic	Single dwelling, sod house
XFI-00020		Historic	Single dwelling, sod house
XFI-00030	Flaxman Island-Brownlow Point Historic District		
XFI-00033	Brownlow cemetery	Historic	Cemetery

Table 3.4.2-3
Documented AHRS Sites in Program Area

AHRS #	Site Name	Period	Resource Description
XFI-00034	Brownlow southern grave	Historic	Isolated grave
XFI-00035		Prehistoric	Artifact scatter
XMM-00001	Camden Bay	Prehistoric	House pit, midden, organic artifacts
XMM-00004		Historic	Sod houses, cellar
XMM-00005		Historic	Sod house ruin
XMM-00006		Historic	Sod house ruin, ice cellar, tent frame remains
XMM-00007		Prehistoric	Tent ring
XMM-00008		Prehistoric	
XMM-00009		Prehistoric	Tent ring, scattered stones of other features
XMM-00010		Prehistoric	
XMM-00011		Prehistoric	
XMM-00012		Prehistoric	Tent ring, hearth(?)
XMM-00013		Prehistoric	
XMM-00014		Prehistoric	
XMM-00015		Prehistoric	
XMM-00016		Prehistoric	
XMM-00017		Prehistoric	
XMM-00018		Historic	Sod house ruins, log cabin, historic debris
XMM-00019		Historic	Sod house, quarry
XMM-00020		Prehistoric	
XMM-00021		Historic	
XMM-00022		Prehistoric	
XMM-00023		Prehistoric	
XMM-00024		Prehistoric	
XMM-00025		Prehistoric	
XMM-00026		Prehistoric	
XMM-00027		Prehistoric	
XMM-00028		Prehistoric	Tent ring, scattered stones of other features
XMM-00029		Historic	
XMM-00030		Prehistoric	
XMM-00031		Historic	
XMM-00032		Historic	
XMM-00033		Historic	
XMM-00034		Prehistoric	
XMM-00035		Prehistoric, Historic	
XMM-00037		Prehistoric	
XMM-00038		Prehistoric	Tent rings
XMM-00039		Historic	
XMM-00040		Historic	
XMM-00041		Historic	Fish camp, tent rings(?)
XMM-00042		Historic	Settlement, winter, reindeer herding
XMM-00043		Historic	Settlement, winter, reindeer herding
XMM-00044		Historic	
XMM-00045		Historic	Cemetery
XMM-00046		Historic	
XMM-00114	(Doe) Camden Bay (AHRS) POW-D	Historic	Building, structure, defense, DEW Line
XMM-00117	Sivugag		

Source: ADNR OHA 2018
Notes: Blank cells indicate no information provided in AHRS database.

Locations of Previously Documented Sites

Due to the confidential and sensitive nature of cultural resource sites, no map is provided in this EIS; however, there are two main locations where cultural resources have been documented in the program area: on barrier islands and protected coasts of the Beaufort Sea, and inland on elevated dry ground landforms, such as pingos, river terraces, and bluffs. Sites of greatest antiquity are found inland, as these landforms appear to have long periods of relative stability. Documented coastal sites are mainly historic, as the dynamic coastal environment appears to cause rapid displacement of sediments and soils through erosion, underlying permafrost thawing, elevated sea levels, and the likely destruction of ancient shoreline sites (CCRS and NLUR 2010). These areas correspond to locations having the highest potential for human activity and where previous surveys have focused. Other undocumented sites are likely present in unsurveyed portions of the program area.

Ethnographic Cultural Resources

Cultural aspects of the environment are not limited only to discrete locations where physical remains of past human activities are preserved, but they may also include culturally valued places, cultural use of the biophysical environment, such as religious and subsistence uses, and sociocultural attributes, such as social cohesion, social institutions, lifeways, religious practices, and other cultural institutions (National Preservation Institute 2018). These ethnographic resources are cultural or natural features of a region, where traditionally associated cultures have formed significant connections. They are closely linked with their own sense of purpose, existence as a community, development as ethnically distinctive peoples, and survival of their lifeways.

Ethnographic resources are held as traditionally meaningful, and may be sites, landscapes, structures, objects, or natural resources, such plants, animals, minerals, and bodies of water, that are assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group. The significance that cultures assigned to ethnographic resources may encompass both the tangible and the intangible aspects of these special places. These types of sites provide knowledge regarding places important to identity, spirituality, and, in the case of ethnographic landscapes, a broader more holistic way of viewing cultural resources in the natural resources that surround them.

Types of ethnographic resources that are identified in cultural resource regulations and guidance documents are as follows:

- Districts
- Traditional cultural properties (TCPs)
- Ethnographic landscapes
- Native American sacred sites

Traditional knowledge provided through such avenues as oral histories and scoping testimonies is one avenue of identifying ethnographic resources. Such knowledge derived from oral histories and public testimony and can be both general—such as testimony on long-standing use of the Arctic environment—or very specific, such as testimony about use of a specific family subsistence camp.

During the scoping process, commenters, particularly the Gwich'in people in Arctic Village and Venetie, expressed the importance of investigating TCPs in the program area. They commented that there should be an emphasis on consultation with local tribal governments and organizations,

nongovernmental agencies, and other interested parties. Broadly speaking, it is evident that the program area is held as sacred among the Gwich'in people, particularly for those residing in Arctic Village and Venetie. They hold it sacred because it is where life begins and for its association with caribou calving and bird nesting grounds (see **Section 3.4.4**, Sociocultural Systems, *Belief Systems*).

Besides the North Slope Borough's TLUI program, surveys and research to identify and document potential sacred sites, TCPs, historic landscapes, or districts have not been completed to date in the program area. Kaktovik commenters stressed the importance of residents being able to maintain, if not increase, their access to and management of traditional areas in the program area and broader Arctic Refuge. Further efforts to describe the process for consulting, identifying, and documenting these types of cultural resource that the Iñupiat and Gwich'in people hold as culturally important will be addressed in accordance with the Section 106 process.

Direct and Indirect Impacts

Alternative A

No direct or indirect impacts to cultural resources would be expected to occur under Alternative A because no leasing activity that could potentially affect cultural resources would occur within the program area. Existing activities that could affect cultural resources would include people using Arctic Refuge lands and waters that could lead to purposeful or inadvertent damage to cultural resources. Additionally, natural processes such as erosion would continue to impact cultural resource sites under this alternative. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

Impacts to cultural resources would not occur from the initial lease sale but would occur with the subsequent actions associated with development of a lease including the exploration, construction, and operation phases of any permitted development. For the program area, examples of direct impacts to cultural resources could include physical destruction of or damage to all or part of a cultural resource, removal of the resource from its original location, change in the character of the resource's use or change of the physical features within the resource's setting (e.g., vibration, noise, visual, olfactory) that contribute to the importance of the resource, or change in access to traditional use sites by traditional users.

Examples of ground disturbing activities that could cause direct impacts include excavation of material sites; construction and maintenance of gravel roads, pads, airstrips, bridges and culverts; construction of ice roads and pads; construction of VSMs for power lines and pipelines; and any other disturbance of the ground surface in the proximity of project components. Other activities and events that could cause direct impacts to cultural resources include seismic and other exploratory activities, damage caused by equipment during the construction, drilling, and operation phases of development projects, and unanticipated accidents such as blowouts, spills, or fires and subsequent cleanup activities. Certain impacts, such as oil spills, can contaminate site artifacts and organic materials to make them undatable. BLM (2012, Section 4.3.12.2) provides additional discussion of potential direct impacts to cultural resources associated with oil and gas exploration and development.

Indirect impacts to cultural resources for the program area leasing and subsequent development could also occur at distances greater than the project footprints. Indirect impacts to cultural resources could occur throughout the construction and operation phases of a development project and during project closure and reclamation. Examples of indirect impacts to cultural resources could include increased access and potential removal, trampling, or dislocation of cultural resources and culturally sensitive areas by personnel and visitors; complete or partial destruction of a site from erosion, melting permafrost, and thermokarsting; the loss of traditional meaning, identity, association, or importance of a resource; effects to beliefs and traditional religious practices, or neglect of a resource that causes its deterioration.

While impacts to specific cultural resource sites would differ by alternative (see discussion below), broader cultural impacts to belief systems/religious practices would be common across all alternatives. Particularly for the Gwich'in who hold the program area as Sacred Ground to their culture and as *Iizhik Gwats'an Gwandaii Goodlit,* "The Sacred Place Where Life Begins" (Gwich'in Steering Committee 2004), the presence of development within the program area would constitute a cultural impact to the Gwich'in who believe that development within the program area will harm the caribou and other migratory resources (such as waterfowl) that migrate to the Coastal Plain to give birth to their young. This sacred pattern of migration and birth maintains the value of, and gives essence to, the Coastal Plain as the place where life began. Similar to the cultural value that Iñupiat place on bowhead whales in their culture, caribou are held in the highest regard by Arctic Village and Venetie Gwich'in and are the backbone of their cultural identity, and any impacts to the resource would constitute a cultural effect. These effects, including the effects to belief systems, are also discussed in **Section 3.4.4**, Sociocultural Systems.

Both Iñupiat and Gwich'in have cultural and ethnographic ties to the program area as evidenced by existing cultural sites, traditional and contemporary uses, oral histories, and current beliefs and values. When these are viewed as a holistic resource, these ties to land and place are often documented and identified within the cultural resource regulatory framework as TCPs or cultural landscapes. These types of cultural resources have not been documented to date within the program area under the existing regulatory frameworks, although the wide array of individual TLUI and AHRS sites within the program area demonstrate the potential for these ethnographic resources (e.g., TCPs, cultural landscapes, sacred sites) to be documented. While the available data (see Affected Environment section above) have not documented these types of cultural resources for Iñupiat or Gwich'in within the program area, the absence of these cultural resources can be attributed to the lack of past research to document these types of resources rather than the fact that they do not exist. Scoping testimony provided by Gwich'in in Arctic Village for this EIS stated that documented and undocumented TCPs do exist for the Gwich'in that they believe could be affected by the proposed leasing in the program area, and that the Section 106 consultation process needs to fully consider these cultural resources. Other scoping testimony identified the Coastal Plain of the Arctic Refuge as a cultural landscape that provides for indigenous communities and that the area should be explicitly analyzed as a traditional cultural landscape of the Gwich'in Nation.

In summary, impacts to traditional belief systems/religious practices and other ethnographic cultural resources such as TCPs and cultural landscapes, particularly for the Gwich'in, would be adverse, regional, and long term. For cultural resource sites within the program area that could not be avoided or that would experience indirect effects, the impacts would be adverse, local, and long term. The Section 106 process for addressing effects to historic properties is occurring concurrently with the

NEPA process and will include the development of a programmatic agreement (PA) to address the process for identifying historic properties and resolving potential adverse effects. Lease stipulations already proposed include conducting cultural surveys prior to ground disturbing activities, a plan for unanticipated discovery stoppage, and cultural awareness training and orientation.

Alternative B

Under Alternative B, the types of impacts to cultural resources would be the same as those described above (Impacts Common to All Action Alternatives). Alternative B would make available the largest number of acres for potential leasing and development and therefore, in terms of direct and indirect impacts to cultural resource sites (e.g., TLUI, AHRS, RS 2477[23] trails), Alternative B could impact the greatest number of documented sites (**Table 3.4.2-4**). A total of 61 AHRS and XX TLUI sites are within areas that are open to Standard Terms and Conditions (STC) and Timing Limitation (TL) leasing and could experience ground disturbing activities. RS 2477 trails #1649 and #914 and two shipwrecks also occur within these areas. An additional 29 AHRS and XX TLUI sites are located in areas of NSO and would have less potential to be impacted due to the reduced levels of ground disturbing activities in the NSO areas. RS 2477 trails #1649 and #1043 occur within the NSO area. Because Alternative B has the smallest setbacks from areas of highest potential for containing undocumented cultural resources (e.g., rivers, coastline), this alternative would have the highest likelihood for impacting undocumented resources. Impacts to cultural resource sites under Alternative B would be adverse, local (up to 2,000 acres of disturbance and general vicinity), and long term for sites that could not be avoided or would experience indirect effects.

Alternative C

Alternative C would have a smaller area available for potential leasing and development compared to Alternative B, with the majority of areas removed from leasing located in the southeastern portion of the program area. Therefore, in terms of direct and indirect impacts to cultural resource sites (e.g., TLUI, AHRS, RS 2477 trails), Alternative C would impact fewer sites than Alternative B. A total of 24 AHRS and XX TLUI sites are within STC/TL areas that are open to leasing and could experience ground disturbing activities (**Table 3.4.2-4**). RS 2477 trail #1649 occurs within these areas. An additional 59 AHRS and XX TLUI sites are located in the NSO area and would have less potential to be impacted due to the reduced levels of ground disturbing activities. RS 2477 trails #914, #1043, and #1649 occur within the NSO area as do the two shipwrecks. Lastly, 10 AHRS sites and XX TLUI sites are located in areas not offered for sale and would not experience impacts. Because Alternative C has a 1-mi pad and CPF exclusion area near the coast, it has a slightly lower likelihood than Alternative B for impacting undocumented cultural resources. Impacts to cultural resource sites under Alternative C would be lower intensity than Alternative B and would be adverse, local (up to 2,000 acres of disturbance and general vicinity), and long term for sites that could not be avoided or would experience indirect effects.

[23] RS 2477 is found in Section 8 of the Mining Law of 1866 and states, "The right of way for the construction of highways over public lands, not reserved for public uses, is hereby granted." This statute granted states and territories ROWs over federal lands that had no existing reservations or private entries. In Alaska, this law effectively ended in 1969, but due to the time frame in which these ROWs were established (1866-1969), these highways, trails, and other ROWs are considered historical resources and taken into consideration in this EIS (ADNR MLW 2013).

Table 3.4.2-4
Cultural Resource Sites by Action Alternative

Alternative	STC/TL	CSU	NSO	No Sale
B	61 AHRS 2 RS 2477 2 shipwrecks	n/a	29 AHRS 2 RS 2477	n/a
C	24 AHRS 1 RS 2477	n/a	59 AHRS 3 RS 2477 2 shipwrecks	10 AHRS
D	1	0	74 AHRS 3 RS 2477 2 shipwrecks	14 AHRS

Notes: Some larger sites may overlap multiple lease areas
STC – Standard Terms and Conditions
TL – Timing Limitations
CSU – Controlled Surface Use
NSO – No Surface Occupancy

Alternative D

Alternative D would make available the fewest number of acres for potential leasing and development and therefore, in terms of direct and indirect impacts to cultural resource sites (e.g., TLUI, AHRS, RS 2477 trails), Alternative D would impact the fewest number of sites. Only one AHRS and XX TLUI sites are within the STC/TL areas that are open to leasing and could experience ground disturbing activities (**Table 3.4.2-4**). An additional 74 AHRS and XX TLUI sites are located in the NSO area and would have less potential to be impacted due to the reduced levels of ground disturbing activities. All three RS 2477 trails occur within the NSO area as do the two shipwrecks. Lastly, 14 AHRS sites and XX TLUI sites are located in areas not offered for sale and would not experience impacts. Because Alternative D has the largest setbacks from areas of highest potential for containing undocumented cultural resources (e.g., rivers, coastline), this alternative would have the lowest likelihood for impacting undocumented resources. Impacts to cultural resource sites under Alternative D would be lower intensity than Alternative B and would be adverse, local (up to 2,000 acres of disturbance and general vicinity), and long term for sites that could not be avoided or would experience indirect effects.

Cumulative Impacts

Past, present, and reasonably foreseeable future activities, in combination with oil and gas development within the program area, would increase the potential for cultural resource impacts, both directly to specific cultural resource sites and other ethnographic resources such as TCPs and cultural landscapes. Past and present actions that have affected cultural resources include oil and gas development, onshore and offshore transportation and infrastructure projects, increased recreation and tourism, and community development. The proposed oil and gas leasing program, in addition to future activities, could lead to additional oil and gas development and other development and infrastructure projects. Cumulative impacts would have the greatest effect on ethnographic resources, such as TCPs and cultural landscapes, which are less easy to avoid (than specific sites) and/or mitigate impacts due to the fact that their significance is tied to historic and present cultural identity, which could be impacted by the presence of development. This cultural identity relates to the cultural importance of the land and its surrounding natural resources (e.g., the Gwich'in and *Iizhik Gwats'an Gwandaii Goodlit,* "The Sacred Place Where Life Begins"). As identified in the GMT2 SEIS, cultural resources on the North Slope are susceptible to climate change effects of erosion, mass wasting, and cryoturbation, which results in

increased melting and lack of preservation of frozen artifacts and loss of spatial relationships between cultural levels.

Alternatives that allow the greatest amount of land to be developed are likely to have the greatest cumulative effect on cultural resources, because they would have the potential to affect a greater number of documented and undocumented cultural resources. Thus, Alternative B would contribute the greatest amount to cumulative effects on cultural resources, while Alternative D would contribute the least to cumulative effects on cultural resources.

3.4.3 Subsistence

Affected Environment

This section summarizes the relevant subsistence activities of communities that use the program area or the resources that are transported through the program area and are harvested elsewhere. For the purposes of this analysis, there are four primary subsistence study communities: Kaktovik, Nuiqsut, Arctic Village, and Venetie. They are the closest to the program area and have contemporary uses in or near the program area or rely heavily on resources that use the program area. In addition, because of the importance of the program area to caribou—particularly the PCH and CAH—this section also includes relevant data on subsistence uses of caribou by 22 Alaskan communities, including the four subsistence study communities listed below, in game management subunits in the PCH and CAH herd ranges, which have Federal Subsistence Board customary and traditional[24] use determinations for caribou (**Map 3-1, Coastal Plain EIS Subsistence Study Communities** in **Appendix A**). In this EIS, these communities are referred to as the caribou study communities.

Many of these communities, such as Fort Yukon, Chalkyitsik, Wiseman, Beaver, Circle, Birch Creek, and Stevens Village, have reported geographic, historic/prehistoric, or cultural ties to the Arctic Refuge as a whole (USFWS 2015). Although not addressed in this subsistence section, Old Crow and other Gwich'in people in Canada also have cultural, historic, and subsistence ties to the Arctic Refuge or the PCH. Additional associated information relevant to subsistence is in **Section 3.4.4**, Sociocultural Systems, which addresses cultural history, social and political organization, mixed cash/subsistence economy, and belief systems; **Section 3.4.2**, Cultural Resources, addresses prehistory/history, archaeological sites, and traditional land use sites.

Subsistence Definition and Relevant Legislation

Subsistence is a central aspect of rural Alaskan life and culture and is the cornerstone of the traditional relationship of the Iñupiaq and Gwich'in people with their environment. Residents of the study communities rely on subsistence harvests of plant and animal resources both for nutrition and for their cultural, economic, and social well-being. Activities associated with subsistence—processing, sharing, redistribution networks, cooperative and individual hunting, fishing, and gathering, and ceremonial activities—strengthen community and family social ties, reinforce community and individual cultural

[24] *Customary and traditional use,* based on federal definitions (36 CFR 242.4), means a long-established, consistent pattern of use, incorporating beliefs and customs that have been transmitted from generation to generation. This use plays an important role in the economy of the community. Where the Federal Subsistence Board has made a customary and traditional use determination regarding subsistence use of a specific fish stock or wildlife population (36 CFR 242.24), only those Alaskans who are residents of rural areas or communities designated by the board are eligible for taking of that population or stock on public lands for subsistence uses.

identity, and provide a link between contemporary Alaska Natives and their ancestors. These activities are guided by traditional knowledge, based on a long-standing relationship with the environment. More than just food, subsistence includes economic, social, cultural, and nutritional elements.

The program area is almost entirely on federal lands managed by the USFWS; a portion of land in the northern program area is owned by the Kaktovik Iñupiat Corporation. In Alaska, subsistence hunting and fishing are regulated under a dual management system by the State of Alaska and the federal government. Subsistence activities on all lands in Alaska, including private lands, are subject to state and federal subsistence regulations. See USFWS (2015) for a more in-depth discussion of subsistence management in the Arctic Refuge.

Overview of Subsistence Uses

The following sections provide a brief overview of subsistence uses for the four study communities, in addition to *Subsistence Uses of the PCH and CAH*, below. Additional subsistence data tables are provided in **Appendix J**, Subsistence Uses and Resources, and maps are provided in **Appendix A**. Other sources provide additional descriptions of subsistence or contain data that are relevant to subsistence but are not directly comparable to the information in this section, such as reported versus estimated harvests and Native households versus all households. These sources include the USFWS (2015), which provides a detailed description of subsistence uses in the Arctic Refuge, and the North Slope Borough (NSB) census reports and community plans (NSB 2016, 2015), which focus on Native households and selected resources.

<u>Kaktovik</u>

Kaktovik residents are the primary subsistence users of the program area, which crossed much of the community's traditional and contemporary area of subsistence use (**Map 3-26, Kaktovik Subsistence Use Areas** in **Appendix A**). Kaktovik use areas from the two previous comprehensive all resources mapping studies show overlap with the program area; for the most recent period (1996 to 2006), the data show the greatest amount of overlapping use areas in the program area occurring along the coast, between Beaufort Lagoon and Brownlow Point, and inland around the Sadlerochit, Hulahula, and Jago Rivers. In addition, high amounts of overlapping subsistence use areas occur offshore from the program area in the Beaufort Sea. All respondents (SRB&A 2010) reported 1996–2006 subsistence uses in the program area.

As shown in **Maps 3-27, Kaktovik Caribou Subsistence Use Areas in Coastal Plain** through **3-37 Kaktovik Polar Bear Subsistence Use Areas in Coastal Plain** in **Appendix A**, Kaktovik use areas overlap with the program area for the following resources: terrestrial mammals (including caribou, moose, grizzly bear, and Dall sheep), furbearers and small land mammals, fish, birds (including geese and eiders), vegetation, and marine mammals (including bowhead whale, seal, walrus, and polar bear). The primary inland subsistence uses for Kaktovik in the program area are caribou, furbearer, and grizzly bear hunting, in addition to limited moose hunting, vegetation gathering, and fishing in select locations along the rivers. The primary coastal subsistence uses that overlap the program area are fishing, harvesting vegetation, and hunting for caribou, geese, eider, and bearded and ringed seals in nearshore areas. Offshore areas are used primarily for hunting bowhead whales, with more limited walrus hunting.

The timing of subsistence activities in Kaktovik is depicted in **Table J-4** in **Appendix J,** Subsistence Uses and Resources. Subsistence activity, in terms of the number of resources targeted, is highest during

the late summer/fall, when residents hunt bowhead whales in addition to targeting caribou, moose, fish, waterfowl, and plants and berries. April is another busy time, when geese arrive in the area and are harvested along the coast and inland. The fewest resources are targeted from December through February, although some residents pursue inland resources, such as furbearers, moose, caribou, and freshwater fish, during this time.

Kaktovik residents access much of their subsistence use along the coast using boats, while inland travel is limited exclusively to four-wheel vehicles along coastal locations in the summer/fall and large overland areas by snowmachine in the winter (**Table J-5** in **Appendix J;** SRB&A 2010). Residents also walk or use vehicles to access subsistence use areas on Barter Island. The program area, which includes coastal, nearshore, and inland subsistence use areas, is accessed using boats and snowmachines, with some inland travel from the coast by four-wheel vehicles.

As shown in **Table 3.4.3-1**, based on years with available data, Kaktovik residents harvest an annual average of 588 pounds of subsistence resources per capita. Marine mammals are the primary resource harvested in terms of edible weight, contributing over 60 percent toward the community's subsistence diet. Large land mammals are the second most harvested resource by edible weight, followed by fish other than salmon and migratory birds. During most years, the primary subsistence species harvested by Kaktovik residents (**Table J-3** in **Appendix J,** Subsistence Uses and Resources) is bowhead whale, caribou, Dolly Varden, Arctic cisco, beluga whale (during some years), bearded and ringed seal, Dall sheep, and moose.

Table 3.4.3-1
Selected Kaktovik Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
All Resources	588	100.0	99	92	83	98
Salmon	1	<1	16	5	6	12
Non-Salmon Fish	57	10.1	87	70	53	72
Large Land Mammals	176	24.7	97	68	60	93
Small Land Mammals	1	<1	45	41	21	22
Marine Mammals	318	62.7	93	72	61	91
Marine Invertebrates	<1	<1	1	1	0	1
Migratory Birds	12	1.9	80	63	45	65
Upland Game Birds	3	<1	80	60	42	47
Bird Eggs	<1	<1	9	6	5	6
Vegetation	1	<1	49	38	15	36

Sources: 1985, 1986 (ADF&G 2018); 1992 (Fuller and George 1999); 1992 (Pedersen 1995a); 1994-95 (Brower, Olemaun, and Hepa 2000); 2000-01, 2001-02 (Pedersen and Linn 2005); 2002-03 (Bacon, Hepa, Brower, Pederson, Olemaun, George, and Corrigan 2009); 2007-2012 (Harcharek, Kayotuk, George, and Pederson 2018); 2010-11 (Kofinas et al. 2016)
Notes: See **Tables J-1, J-2,** and **J-3** in **Appendix J** for data by study year.

Over 90 percent of Kaktovik households participate in one or more subsistence resource harvesting activities, with over two-thirds of households participating in marine mammal hunting, fishing, and large land mammal hunting. Sharing is a central aspect of Kaktovik subsistence. A recent BOEM-funded study on sharing networks documented Kaktovik households giving an average of 3.1 and receiving 4.5 "core species." Sharing networks extend across nearly all regions of Alaska and to other states (Kofinas et al. 2016).

An analysis of resource importance based on material (percentage of total harvest) and cultural (percentage of households harvesting and percentage of households receiving) is provided in **Table J-6** in **Appendix J** (see USACE [2012] for a description of the method used). Based on this analysis, resources of major importance in Kaktovik are bearded seal, Bering cisco, bowhead whale, caribou, Dall sheep, Dolly Varden/Arctic char, ptarmigan, and wood.

<u>Nuiqsut</u>

Nuiqsut is west of the program area, where there are limited subsistence uses; however, Nuiqsut residents harvest resources that migrate through the area (**Map 3-38, Nuiqsut Subsistense Use Areas** in **Appendix A**). For the most part, Nuiqsut subsistence users utilize lands west of the Prudhoe Bay area, although many of the lands in the area were traditionally used by Nuiqsut people. In addition, the community's whaling grounds are based out of Cross Island, and whaling sometimes extends offshore of the program area. As shown in **Maps 3-39, Nuiqsut Whales Subsistence Use Areas in Coastal Plain** through **3-41, Nuiqsut Wolf and Wolverine Subsistence Use Areas in Coastal Plain** in **Appendix A**, Nuiqsut use areas overlap the program area for marine mammals (bowhead whale and ringed/bearded seal; three mapping studies) and furbearers (wolf and wolverine; one mapping study).

For the most recent period (1995 to 2006), bowhead whale and seal use areas overlap the program area in nearshore areas east of Flaxman Island. Cross Island whaling crews travel this far east during certain years, depending on ice conditions and resource availability. During certain years, whaling crews have reported disturbances in their hunting area from vessel traffic and seismic activity. A wolf and wolverine hunting area, likely reported by a single hunter, was documented extending overland from Nuiqsut's core hunting area and crossing the Sadlerochit, Hulahula, and Jago Rivers. Use areas overlapping the program area were reported by four Nuiqsut respondents (12 percent) (SRB&A 2010). Nuiqsut residents harvest caribou primarily from the Teshekpuk Herd and the CAH, which sometimes passes through the program area before heading west toward the Colville River delta.

Data on the timing of Nuiqsut subsistence activities are depicted in **Table J-9** in **Appendix J,** Subsistence Uses and Resources. August and September is the peak of hunting and harvesting in Nuiqsut, when residents station whaling crews at Cross Island, hunt moose and caribou, and harvest fish. October/November is a crucial time for subsistence in the community, when residents set nets for Arctic cisco (*qaaktak*) as they run upriver. These *qaaktak* are the same that originate in the Mackenzie River delta and migrate west along the coast, passing by the program area, before arriving at their destination in the Colville River delta.

Winter activities are limited primarily to furbearer and caribou hunting, with some fishing through the ice. Residents travel by snowmachine and boat during the spring to hunt waterfowl and then travel offshore and inland during the summer by boat to hunt seals and caribou, set nets for broad whitefish, fish for grayling and Dolly Varden, and harvest berries. Boats are the most commonly used method of transportation for Nuiqsut subsistence activities, although snowmachines are necessary for inland pursuits, such as wolf and wolverine hunting and geese hunting (**Table J-10** in **Appendix J**, Subsistence Uses and Resources). In recent years, ATVs and trucks have become more commonly used during the summer and fall, when residents hunt caribou to the west of the community (SRB&A 2017).

As shown in **Table 3.4.3-2**, based on years with available data, Nuiqsut residents harvest an annual average of 679 pounds of subsistence resources per capita. Marine mammals, large land mammals, and fish other than salmon contribute nearly equal amounts toward the subsistence harvest, although bowhead whaling success often determines the relative contribution of other resources (**Table 3.4.3-2**, and **Table J-7** in **Appendix J**). During most years, the primary subsistence species harvested by Nuiqsut residents (**Table J-8** in **Appendix J**) are bowhead whale, caribou, Arctic cisco, broad whitefish, bearded and ringed seal, white-fronted geese, and moose.

One hundred percent of Nuiqsut households report using subsistence resources, and 95 percent participate in one or more subsistence resource harvesting activity, with over two-thirds of households participating in harvests of fish other than salmon, large land mammals, and migratory birds. Household participation in bowhead whale hunting is relatively limited, due to the substantial distance of the whaling site (Cross Island) from the community and the required absence from the community. Nuiqsut residents consider sharing to be central to their identity; the bowhead whale hunt, in particular, centers on sharing, as evidenced by the 97 percent of households who receive bowhead whale meat annually.

Table 3.4.3-2
Selected Nuiqsut Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
all resources	679	100.0	100	95	93	98
Salmon	5	<1	65	43	31	35
Fish other than salmon	209	30.6	97	81	81	79
Large land mammals	224	32.6	96	77	77	78
Small land mammals	<1	<1	45	41	17	12
Marine mammals	226	33.8	97	54	60	97
Migratory birds	13	2.3	85	78	58	52
Upland game birds	2	<1	54	48	36	15
Bird eggs	<1	<1	24	16	8	11
Vegetation	1	<1	61	52	19	33

Sources: 1985 (ADF&G 2018); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994-95 (Brower and Hepa 1998); 1995-96, 2000-01 (Bacon et al. 2009); 2014 (Brown, Braem, Mikow, Trainor, Slayton, Runfola, Ikuta, Kostick, McDevitt, Park, and Simon 2016)
Notes: See **Tables J-7** and **J-8** in **Appendix J** for data by study year.

An analysis of resource importance based on material (percentage of total harvest) and cultural (percentage of households attempting harvests; percentage of households receiving) is provided in **Table J-11** in **Appendix J**, Subsistence Uses and Resources. Based on this analysis, resources of major importance in Nuiqsut are Arctic cisco, Arctic grayling, bearded seal, bowhead whale, broad whitefish, burbot, caribou, cloudberry, white-fronted geese, and drift wood.

<u>Arctic Village</u>

Arctic Village is south of the program area, on the south side of the Brooks Range, along the East Fork Chandalar River. As shown in **Map 3-42, Arctic Village and Venetie Subsistence Use Areas** in **Appendix A**, Arctic Village subsistence use areas do not overlap the program area; however, Arctic Village is on the Arctic Refuge boundary, so most subsistence activities do extend into the refuge. Resource uses farthest north toward the program area are sheep and caribou hunting and furbearer harvesting.

Arctic Village and other northern Gwich'in people consider caribou their most important food source and refer to themselves as the caribou people (see **Section 3.4.4,** Sociocultural Systems). Caribou from the PCH calve in the program area, and for this reason, it is considered sacred ground to the Gwich'in people (USFWS 2015). Subsistence harvesting by Arctic Village residents generally occurs on their lands or in the Arctic Refuge south of the program area. Key harvesting locations are Old John Lake, the Chandalar, Sheenjek, Junjik, and Wind rivers, and Red Sheep Creek (USFWS 2015).

Data on the timing of Arctic Village subsistence activities are depicted in **Table J-14** in **Appendix J**. In terms of the number of resources targeted, the fall and winter are the most active times for subsistence harvesters in Arctic Village. From August through October, residents target a variety of large land mammals, including caribou, moose, and Dall sheep, in addition to fishing and harvesting wood for the upcoming winter. The fall is particularly important for caribou hunting, as residents wait for caribou from the PCH to migrate through their traditional hunting grounds after the PCH has spent the spring and summer on the North Slope, including in the program area (USFWS 2015). Caribou hunting continues through the winter as caribou are available, and residents also set traps during this time. The spring and summer are primarily dedicated to the harvest of waterfowl and fish.

Data that estimate harvest for the entire community are limited to less complex studies documenting harvests of migratory birds and fish. As shown in **Table 3.4.3-3**, based on three years of limited data, Arctic Village residents harvested an average of 51 pounds of non-salmon fish per capita, and six pounds of migratory birds per capita. Scoters were the most commonly harvested migratory bird, followed by scaup, long-tailed ducks, mallards, and white-fronted geese. Whitefish – particularly humpback whitefish and broad whitefish, contributed the greatest amount to the non-salmon fish harvest, with Arctic grayling and northern pike also contributing substantial amounts (**Table J-13** in **Appendix J**, Subsistence Uses and Resources). An average of 70 percent of households use non-salmon fish (**Table 3.4.3-3**), and half of Arctic Village households report harvesting fish other than salmon. Forty-six percent reported harvesting migratory birds during the 2000 study year and 87 percent used migratory birds (**Table J-12** in **Appendix J**).

Table 3.4.3-3
Selected Arctic Village Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
Non-Salmon Fish	51	—	71	—	23	35
Migratory Birds	6	—	—	—	—	—

Sources: 2000 (Andersen and Jennings 2001); 2001, 2002 (ADF&G 2018)
Note: See **Tables J-12 and J-13 in Appendix J** for data by study year.

The USFWS (2015) states that, based on reported harvests alone and not community-wide estimates, moose and caribou comprised more than 90 percent of the harvest by weight during harvest years in the 1990s and early 2000s. These data (Council of Athabascan Tribal Governments 2005, 2003, 2002) are not estimated for the entire community or have low response rates. Because of this, they are not comparable to the more comprehensive surveys, which report estimated harvests for the community as

a whole. These data are not described here;[25] however, the reported percentages demonstrate that moose and caribou are highly important to the subsistence harvest of Arctic Village.

Data to calculate resources of importance for Arctic Village are not available, as there have been no comprehensive household harvest surveys in that community; however, based on existing literature reviews and statements from community members during public scoping and elsewhere, the assumption is that caribou, among other resources, are a resource of major material and cultural importance for Arctic Village.

<u>Venetie</u>

Venetie is south of Arctic Village on the Chandalar River. As shown on **Map 3-42, Arctic Village and Venetie Subsistence Use Areas** in **Appendix A**, Venetie subsistence use areas do not overlap the program area. As with Arctic Village and other Gwich'in people, Venetie residents consider caribou to be a primary food source and central to their cultural identity (see **Section 3.4.4,** Sociocultural Systems). Subsistence harvesting by Venetie residents generally occurs on tribal lands surrounding their community and surrounding the Chandalar (including the East and Middle Forks), Yukon, Christian, and Hadweenzic Rivers (Caulfield 1983; Van Lanen et al. 2012). Caribou are primarily available to Venetie and Arctic Village residents along the upper Chandalar River drainage and the foothills of the Brooks Range (Van Lanen et al. 2012).

Data on the timing of Venetie subsistence activities are listed in **Table J-18** in **Appendix J**. In terms of the number of resources targeted, the spring and fall are the most active times for subsistence harvesters in Venetie. Fishing and hunting of waterfowl, black and brown bears, and small land mammals (they trap muskrats and ground squirrels) are common activities during April and May; these activities continue through the summer and into the fall. Berries are harvested also during summer and early fall. As with Arctic Village, caribou hunting begins in the fall (generally August), when caribou from the PCH begin their annual migration through northern Gwich'in hunting grounds. Residents also hunt moose during the fall and continue to hunt both moose and caribou through the winter, along with trapping furbearers.

Data on subsistence harvests for Venetie are provided in **Tables J-15** through **J-17** in **Appendix J** and in **Table 3.4.3-4**, below. Venetie data are limited to one comprehensive study of all subsistence resources (2009), in addition to several years of data for migratory birds and land mammals. As shown in **Table 3.4.3-4**, based on years with available data, Venetie residents harvest an annual average of 274 pounds of subsistence resources per capita. Large land mammals constitute approximately half of the subsistence harvest in terms of edible pounds. Also important are harvests of salmon, fish other than salmon, and migratory birds (Kofinas et al. 2016).

The primary subsistence species for Venetie residents are moose, caribou, chum and chinook salmon, grayling, geese, and whitefish. Ninety-nine percent of Venetie households report using subsistence resources, and 86 percent participate in subsistence activities. Over half of the households participate in harvests of large land mammals, fish other than salmon, and migratory birds. A recent BOEM-funded study documented Venetie sharing networks extending throughout the state, but with a focus on nearby

[25] ADF&G, the primary repository for subsistence harvest data in Alaska, removed these data from their Community Subsistence Information System due to data quality concerns.

interior communities, such Arctic Village, Fort Yukon, Eagle, Chalkyitsik, Stevens Village, Beaver, and Birch Creek. Venetie residents also have sharing networks with multiple North Slope communities, including Utqiaġvik, Nuiqsut, and Anaktuvuk Pass (Kofinas et al. 2016).

An analysis of resource importance, based on material (percentage of total harvest) and cultural (percentage of households attempting harvests; percentage of households receiving) is provided in **Table J-19** in **Appendix J**, Subsistence Uses and Resources. Based on this analysis, resources of major importance in Venetie are Arctic grayling, caribou, chinook salmon, chum salmon, and moose.

Table 3.4.3-4
Selected Venetie Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
All Resources	274	100.0	99	86	—	—
Salmon	76	27.8	76	37	—	—
Non-Salmon Fish	25	9.0	81	67	—	—
Large Land Mammals	95	49.6	94	63	—	—
Small Land Mammals	12	4.2	56	44	—	—
Marine Mammals	0	0.0	18	0	—	—
Migratory Birds	27	7.4	79	57	—	—
Upland Game Birds	<1	<1	20	31	—	—
Bird Eggs	—	—	—	—	—	—
Vegetation	5	1.8	67	46	—	—

Sources: 2000 (Andersen and Jennings 2001); 2009 (Kofinas et al. 2016); 2008-09, 2009-10 (Van Lanen et al. 2012), 2010-11 (Stevens and Maracle n.d.)
Note: See **Tables J-15**, **J-16, J-17** in **Appendix J** for data by study year.

Subsistence Uses of the PCH and CAH

Table J-20 in **Appendix J** provides caribou use and harvest data for all of the 22 caribou study communities depicted on **Map 3-25, Coastal Plain EIS Subsistence Study Communities** in **Appendix A**, along with data averages for each study community across all available study years. The 22 communities on **Map 3-25, Coastal Plain EIS Subsistence Study Communities** in **Appendix A** have documented customary and traditional uses for caribou in GMU subunits that are in the ranges of the CAH and PCH. The harvest and sharing patterns of these 22 communities are relevant if the leasing program changes caribou resource availability or abundance for those communities.

With few exceptions, use of caribou among the 22 study communities is high; over 50 percent of households in Bettles, Eagle, Evansville, Allakaket, Venetie, Coldfoot, Wiseman, Alatna, Utqiaġvik. Anaktuvuk Pass, Point Lay, Kaktovik, Atqasuk, Nuiqsut, and Wainwright use caribou. Less than 5 percent of households in Stevens Village, Beaver, and Chalkyitsik have reported using caribou during years when data are available. The contribution of caribou toward the total subsistence harvest is highest in the communities of Anaktuvuk Pass (84 percent) and Coldfoot (85.3 percent) and lowest in the communities of Fort Yukon (2.5 percent) and Evansville (4.9 percent). Four communities reported zero harvests of caribou during available study years: Birch Creek, Stevens Village, Beaver, and Chalkyitsik. Caribou sharing ranges widely, with 0 percent receiving caribou in Beaver and Chalkyitsik during reported study years; between 8 and 28 percent of households receiving caribou in Stevens Village,

Wiseman, Birch Creek, and Fort Yukon; and at least 30 percent of households receiving caribou in the remaining study communities.

Direct and Indirect Impacts

This section describes the potential direct (i.e., occurring at the same time or place as development activity or infrastructure) and indirect (i.e., those occurring later in time or are farther removed from development activity or infrastructure) impacts of the proposed oil and gas leasing program on subsistence uses and resources, including impacts on user access, resource availability, and resource abundance, which following BLM Alaska guidance (IM No. AK-2011-008) are the three impact categories that must be addressed to inform the ANILCA 810 analysis (see **Appendix C,** Section 810 Analysis). Common types of direct and indirect effects associated with oil and gas development within the program area include changes in subsistence use areas, harvest success, harvest amounts, participation, costs and time, competition, culture, and access (both physical/legal barriers and user avoidance). For most actions, impacts can only be described qualitatively because project details are uncertain or unknown at the time of this preliminary analysis.

Alternative A

Under Alternative A, no oil and gas leasing program would take place within the program area, and therefore subsistence uses among the Iñupiaq and Gwich'in peoples would be unaffected by oil and gas development within the Coastal Plain. Existing impacts on subsistence—including oil and gas development to the west of the program area, increased vessel traffic within the Beaufort Sea, infrastructure and transportation projects, environmental and biological changes affecting subsistence resources, changes in land status, and hunting and fishing regulations—would continue to occur. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

This section discusses impacts to subsistence uses and resources which are common to all alternatives. The primary factors which may result in impacts to subsistence resources and uses include: 1) noise, traffic, and human activity, 2) infrastructure (including physical barriers), 3) contamination, 4) legal or regulatory barriers, and 5) increased employment or income/revenue. These factors could affect resource availability, resource abundance, and user access for residents of the study communities. It should be noted that the label of "short term" does not necessarily reflect the level of impact to subsistence uses, and an impact lasting four years, for example, could have a large effect to subsistence uses.

In all cases, development activities have the potential to affect subsistence uses of resources of major importance for the subsistence study communities (see **Tables J-6, J-11, and J-19** in **Appendix J**). As described in the Affected Environment section above, Kaktovik is the primary user of the program area and would therefore be most likely to experience direct impacts associated with development activities. Nuiqsut has the potential to experience direct and indirect impacts associated with harvests of marine mammals (e.g., bowhead whale) and indirect impacts associated with harvests of caribou, waterfowl, and fish. Arctic Village, Venetie, and other communities who use the PCH and CAH herds, have the potential to experience indirect impacts associated with caribou and, to a lesser extent, waterfowl. In

the case of the 22 caribou study communities (**Table J-20** in **Appendix J**), communities with a greater reliance on caribou would be more likely to experience indirect impacts related to caribou abundance or availability. Those communities with the greatest reliance (where caribou accounts for greater than 10 percent of the annual subsistence harvest, on average, and over 50 percent of households use the resource include the 12 communities of Alatna, Anaktuvuk Pass, Utqiaġvik, Bettles, Coldfoot, Eagle, Kaktovik, Nuiqsut, Point Lay, Venetie, Wainwright, and Wiseman. In an additional three communities (Allakaket, Atqasuk, and Evansville), caribou accounts for less than 10 percent (or data are not available), but over 50 percent of households use caribou (**Table J-20** in **Appendix J**). Impacts, particularly those relating to changes in calving distribution and calf survival, are expected to be more intense for the PCH because of their lack of previous exposure to oil field development (see **Section 3.3.5**, Terrestrial Mammals). Therefore, caribou study communities within the PCH range that have the greatest reliance on caribou are most likely to experience impacts from the leasing program and would include the communities of Kaktovik, Venetie, and Eagle. In addition, Arctic Village, although lacking harvest data, would also be most likely to experience impacts due to their proximity and reported reliance on the PCH.

<u>Noise, Traffic, and Human Activity</u>

Noise, traffic, and human activity associated with the leasing program may result from construction; gravel mining; air, vessel, and ground traffic; seismic activity; drilling noise; and human presence. Noise, traffic (both ground and air), and human activity can cause both direct and indirect impacts on subsistence users. Impacts related to noise and traffic have been a primary concern reported by subsistence harvesters on the North Slope and elsewhere. Noise and traffic associated with the leasing program could affect the availability of resources such as caribou, marine mammals, furbearers and small land mammals, fish, and migratory birds. While most impacts related to noise and traffic would be local in extent, occurring in areas where Kaktovik subsistence use areas overlap with action areas, certain impacts, particularly those related to caribou migration, could extend outside the program area and would be regional.

According to traditional knowledge of North Slope Iñupiat, furbearers, caribou, and marine mammals are particularly sensitive to noise and human activity (SRB&A 2017, 2009a). Potential impacts on caribou availability include displacement of caribou from areas of heavy oil and gas activity, diversion of caribou from their usual migratory routes, and skittish behavior which results in reduced harvest opportunities (SRB&A 2017). Air traffic—particularly helicopter traffic—has been the most commonly reported impact on caribou hunting activities by Nuiqsut harvesters since the Nuiqsut Caribou Subsistence Monitoring Project began in 2009. Residents note that air traffic can cause skittish behavior in caribou, either causing them to stay inland from riversides or diverting them from their usual migration and crossing routes (see **Section 3.3.5**, Terrestrial Mammals); such impacts could occur for Kaktovik harvesters as they travel along the coast by boat or inland by snowmachine looking for caribou. Ground traffic has also been observed diverting or delaying caribou movement across roads, and biological research have shown caribou, especially cows with calves, avoiding roads and other areas of human activity (see **Section 3.3.5**, Terrestrial Mammals). These responses may be more likely for PCH caribou as they have had less exposure to development than the CAH. If development causes large scale displacement from PCH calving grounds, then the herd could experience a decline in calf survival and stagnant herd growth. In addition to large land mammals, furbearers such as wolf and wolverine may avoid areas of heavy traffic, drilling noise, seismic testing, and other activity. ROPs H-1 and H-2 associated with "Subsistence Consultation for Permitted Activities" would require consultation with

potentially affected communities regarding the timing, siting, and methods of development activities including seismic activities.

Impacts on marine mammals from noise and traffic have also been reported by whaling crews and marine mammal hunters in Kaktovik and Nuiqsut (SRB&A 2009a). As noted in the Affected Environment discussion, Kaktovik whaling crews hunt offshore from the program area and Nuiqsut whaling crews hunt to the west of the program area from Cross Island, sometimes hunting in areas offshore from the program area. Whaling crews have reported skittish behavior in bowhead whales and other marine mammals during times of heavy air and vessel traffic, and during seismic exploration. Such activity can divert bowhead whales farther from shore or cause unpredictable behaviors, resulting in greater risks to hunter safety (SRB&A 2009a; Galginaitis 2014). If conflict avoidance agreements (CAAs) between Industry and the Alaska Eskimo Whaling Commission continue in relation to the proposed oil and gas leasing program, then impacts on whaling activities are unlikely. It is important to note that not all vessel traffic (e.g., barging not associated with oil and gas development) is subject to CAAs and therefore impacts could occur even with a CAA in place. However, CAAs are generally considered an effective measure by whaling crews, industry, and agencies (SRB&A 2013). Because seismic exploration and activity would be limited to the winter months, impacts on marine mammals harvesting related to seismic testing would be unlikely.

Noise and traffic associated with oil and gas development would also cause disturbances of subsistence resources such as birds and fish and could cause temporary reductions in harvesting success for Kaktovik harvesters. However, most displacement would be temporary and would not cause changes in overall population levels (**Section 3.3.3,** Fish and Aquatic Resources and **Section 3.3.4,** Birds). Impacts of noise on fish would be relatively limited, as most impact sources (e.g., seismic activity, pile driving) would occur during the winter.

The above impacts to resource availability may be considered localized from a biological standpoint; however, small localized changes can have larger impacts on subsistence harvesters when resources are not present in traditional hunting areas at the expected times and in adequate abundance. Residents may experience reduced harvest success, increased costs and time, and increased safety risks if resources are less available. While impacts on resource availability related to noise and traffic are most likely to be local in extent (e.g., Kaktovik or Nuiqsut residents who use the program area), more widespread changes in migration or abundance resulting from noise and traffic and infrastructure (see discussion below) could cause regional impacts extending outside the program area to other communities (e.g., the Gwich'in communities of Arctic Village and Venetie) who harvest from the PCH and CAH (see **Table J-20** in **Appendix J**). In addition, reduced harvests by Kaktovik residents could disrupt existing sharing networks to other communities and regions if residents are unable to share as widely or frequently as they are accustomed.

In addition to affecting resource availability, noise, traffic, and human activity may also affect user access by deterring subsistence users from their usual harvesting areas. Avoidance of subsistence use areas due to development activity has been documented for the community of Nuiqsut (SRB&A 2017) and would likely occur for some Kaktovik harvesters if development occurs within their harvesting areas during subsistence harvesting times. Residents may experience discomfort hunting in the presence of outsiders; avoid hunting near areas of high air or ground traffic because of a perceived or actual reduction in the

availability of subsistence resources; avoid hunting near human activity due to safety concerns; or simply dislike the experience of hunting near noise and human activity.

<u>Infrastructure</u>

Infrastructure associated with the leasing program could include gravel and ice roads, pipelines, gravel pads, bridges, gravel mines, and runways. While most impacts related to infrastructure would be site-specific or local, occurring in and around action areas, certain impacts—particularly those related to caribou migration and abundance—could extend outside the planning area and would be regional.

Infrastructure could cause loss of subsistence use areas due to direct overlap (**Map 3-43, Kaktovik Subsistence Use Areas and Areas of Hydrocarbon Potential** in **Appendix A**). Much of the coastline in the area of high HCP shows high overlapping use by the community of Kaktovik for subsistence purposes, particularly for caribou, fish, and waterfowl (**Maps 3-27, Kaktovik Caribou Subsistence Use Areas in Coastal Plain, 3-31, Kaktovik Fish Subsistence Use Areas in Coastal Plain,** and **3-32, Kaktovik Bird Subsistence Use Areas in Coastal Plain** in **Appendix A**). While actual infrastructure would be limited to a smaller proportion of the overall development area, areas excluded from subsistence use would likely be greater than the actual footprint, either due to avoidance or security and firearm restrictions. Up to 50 percent of harvesters may avoid development activities or infrastructure at one time or another over the period of development (SRB&A 2017). If development extends into areas of medium and low potential for oil and gas development, as is expected, associated infrastructure could extend throughout areas of high overlapping use for the community of Kaktovik and could present a barrier (either perceived or actual) between the community and more highly used inland hunting areas for caribou, wolf/wolverine, moose, Dall sheep, and fish (**Maps 3-27, Kaktovik Caribou Subsistence Use Areas in Coastal Plain** through **3-31, Kaktovik Fish Subsistence Use Areas in Coastal Plain** in **Appendix A**).

Infrastructure could pose as physical obstructions to subsistence users if roads and pipelines are not designed to account for overland hunter travel. Some residents in Nuiqsut have reported difficulty safely crossing over certain gravel roads with snowmachines or four-wheelers due to the steep side slopes (SRB&A 2017). Kaktovik hunters frequently travel by boat to the west and east of the community, searching for caribou as they congregate along the coast during the insect relief season. Pipelines in coastal areas could cause physical obstructions for these individuals; residents may be unable to shoot inland or may have to expend extra effort accessing suitable use areas if pipelines are situated too close to the coast. As noted in USACE (2012), such impacts would be particularly likely if pipelines are within 1 or 2 mi of the coast. Increased use of roads or changes in travel routes due to the presence of infrastructure could increase the likelihood of injuries and accidents for Kaktovik harvesters (see **Section 3.4.11**, Public Health and Safety). ROPs 19 and 25 (**Chapter 2**) would minimize direct obstructions to subsistence uses from roads and pipelines. However, impacts to access may still occur due to some harvesters avoiding industry.

If Kaktovik residents have easy access to project roads, it is likely that some will use the roads to access subsistence harvesting areas, particularly during times when overland snowmachine travel is difficult and for residents who do not have access to overland modes of travel such as snowmachines and four-wheelers. Use of project roads would be less likely or frequent if the roads are not connected to the community of Kaktovik or only connected seasonally via ice roads. The use of project roads for subsistence activities can introduce benefits and impacts to subsistence users. Benefits include facilitating

access to areas at times when access is difficult; providing access for community residents who do not own snowmachines, four-wheelers or boats; and allowing residents to access resources when they are unavailable closer to the community. Impacts include increased competition between community residents along newly introduced hunting corridors and the deflection of caribou from areas closer to the community because of traffic and hunting activity along the road (SRB&A 2017).

Similar to noise, traffic, and human activity, infrastructure could also affect the availability of certain resources through changes in resource abundance, migration/distribution, and behavior. Infrastructure would be most likely to affect migratory terrestrial resources, particularly caribou, but could also affect furbearers, waterfowl, and fish. Infrastructure could divert or impede caribou movement, displace waterfowl from nesting and other habitat, and displace fish from nearshore or riverine habitats, at least temporarily. Studies on the North Slope show that caribou distribution, especially cows with calves, changes around transportation corridors, and that a percentage of caribou (approximately 30 percent) are influenced in their movement by the presence of roads (NRC 2003; Wilson et al. 2016). Development in the areas of high, medium, and low oil and gas potential could present obstacles to caribou migrating from inland areas to the coast where many Kaktovik residents hunt them; while infrastructure is not expected to divert caribou migration altogether, linear features occurring perpendicular to migratory routes could slow caribou movement through the area resulting in changes in the herd/group sizes and timing of their availability along the coast (NRC 2003; Wilson et al. 2016) (see **Section 3.3.5**, Terrestrial Mammals). Avoidance of roads is particularly likely during times of high human activity including ground traffic. Oil and gas infrastructure within the program area is expected to result in long-term loss and alteration of bird habitat; however, these changes are not expected to cause overall changes in bird populations (**Section 3.3.4**, Birds). Infrastructure could affect fish habitat by causing habitat loss, increased turbidity from dust and gravel spray, reduced fish passage, and reduced water quantity (**Section 3.3.3**, Fish and Aquatic Species).

According to **Section 3.3.5**, Terrestrial Mammals, oil and gas infrastructure within the program area, particularly in the PCH calving grounds, could cause a shift in calving distribution during some years, which would likely reduce calf survival and halt herd growth. To the extent that calving grounds are disturbed by oil and gas development, a reduction in the PCH calf survival and herd numbers could occur. An overall reduction in the PCH could also affect harvest success among Iñupiaq and Gwich'in caribou hunters. It is equally important to note that according to the Gwich'in knowledge, any development within the program area would have devastating effects on the population of the PCH and other resources, such as migratory birds, that have key habitat within the coastal plain; in addition there are those among the Iñupiat who report similar knowledge regarding the effects of Arctic Coastal Plain development (BLM 2018a, b, c, d). These concerns are based on their own observations of the sensitivity of resources to development and change, in addition to traditional knowledge that has been passed on through generations.

<u>Contamination</u>

Real or perceived contamination, including contamination from oil spills and air pollution, could affect resource availability and user access. If an oil spill causes reduced abundance or reduced health of certain resources, then they could become less available to the subsistence users. Impacts on resources from oil spills would be most likely for marine and riverine resources such as fish, seals, and bowhead whales, as oil spills on land would be largely contained. Small spills in the program area or air contamination (either real or perceived) could also cause subsistence users to avoid harvesting certain

resources, particularly near development areas, which could have indirect effects on human health through reduced consumption of nutritional foods (**Section 3.4.11**, Public Health). Impacts from contamination are most likely to occur for Kaktovik residents and would be local; however, in the event of a large-scale oil spill or other contamination event, subsistence users who harvest resources that use or pass through the development area—such as those from Nuiqsut, Arctic Village, and Venetie—may also experience reduced resource availability. Thus, impacts related to contamination would be of local to regional context. Monitoring of air quality and contaminants in subsistence foods ("Waste Prevention, Handling, Disposal, Spills, and Public Safety" ROPs 7 and 8) would help address subsistence user concerns related to contaminants and identify potential human health concerns.

<u>Legal or Regulatory Barriers</u>

Legal or regulatory barriers—including restrictions on access and firearm discharge near oil and gas facilities—could result in reduced user access and resource availability in traditional use areas. Hunters will likely be subject to certain restrictions regarding discharging firearms near pipelines, roads, and other facilities. Depending on the parameters of such restrictions (e.g., the distance at which one can discharge a firearm), subsistence users may have difficulty hunting in certain areas, particularly in areas where pipelines or roads parallel the coast. Miscommunication surrounding rules and restrictions around oil and gas facilities, as has been documented in the case of Nuiqsut (SRB&A 2017), may dissuade residents from accessing development areas. Impacts related to legal or regulatory barriers are most likely to occur for Kaktovik and would be of local extent; however, whaling crews from Nuiqsut could potentially experience impacts when hunting offshore from the program area. Lease Stipulation 11 would require consultation with the community of Kaktovik to develop a subsistence access plan.

<u>Employment and Revenue</u>

Increased employment and revenue related to oil and gas development could have positive and negative impacts on subsistence uses in affected communities. Increased income from employment and corporation dividends would likely be put to use in supporting subsistence activities through the purchase of faster and more efficient equipment and technologies, and through supporting super-harvester households in the community. However, an increase in employment could also cause a shift in subsistence roles in the community, as employed individuals may have less time to engage in subsistence activities (see **Section 3.4.4**, Sociocultural Systems). These impacts would be most likely to occur for Kaktovik (see **Section 3.4.10**, Economy), which is most likely to see an increase in employment and income resulting from the proposed oil and gas leasing program. However, increased income resulting from dividends could extend throughout the North Slope and would therefore be of regional context.

<u>General Development and Culture</u>

Overall, development within the program area could have lasting effects on cultural practices, values, and beliefs through its impacts on subsistence. To the extent that the impacts of development result in reduced harvests, changes in uses of traditional lands, and decreased community participation in subsistence harvesting, processing, sharing, and associated rituals and feasts, then communities could experience a loss of cultural and individual identity associated with subsistence; a loss of traditional knowledge about the land; damaged social and kinship ties; and effects on spirituality associated with degradation of the Alaska coastal plain. These are key concerns which were reported by the Iñupiaq and Gwich'in people during public scoping meetings associated with the oil and gas leasing program (BLM 2018a, b, c, d)

Alternative B

Under Alternative B, the types of impacts on subsistence uses and resources would be the same as those described above (Impacts Common to All Action Alternatives). The duration of all types of impacts would be long-term, although certain specific impacts (e.g., seismic activity, construction noise) would only occur during the exploration and construction phases of individual development plans. Direct impacts on resource availability, resource abundance, and user access related to noise, traffic, and human activity; infrastructure; contamination; and legal or regulatory barriers would occur primarily for Kaktovik residents who use the program area. Indirect impacts on resource availability and resource abundance resulting from noise, traffic, and human activity; infrastructure; and contamination could extend outside the program area to other communities such as Nuiqsut, Arctic Village, Venetie, and communities who harvest from the PCH and CAH (**Table J-20** in **Appendix J**). User access impacts related to an increase in employment rates or income are most likely for the community of Kaktovik but could extend to other communities on the North Slope.

Because of its proximity to the program area and the high potential for development activity within areas of high overlapping use, the community of Kaktovik would experience the greatest intensity of both impacts and benefits associated with the proposed oil and gas leasing program. Impacts on subsistence resources and uses may also occur for other communities if oil and gas development in the program area results in changes to resource abundance and/or availability, particularly caribou which is a resource of major importance to the communities of Kaktovik, Nuiqsut, Arctic Village, and Venetie (see **Tables J-6, J-11, and J-19** in **Appendix J**). Under Alternative B, 733,100 acres of calving habitat would be available for leasing, which would result in the greatest potential impact to calf survival and overall herd numbers. In addition, Alternative B would include 0.5-1 mi setbacks (with no permanent oil and gas infrastructure, including roads and pipelines, allowed) for 8 major rivers, many of which (e.g., Hulahula, Okpilak, and Jago rivers) are key drainages used for subsistence activities. Some timing restrictions on human activity would be in place for calving and post calving habitats of the PCH which could reduce impacts to resource abundance and availability.

Alternative C

The types of impacts under Alternative C would be the same as those described under Alternative B. Under Alternative C, fewer acres overlapping PCH calving grounds would be available for lease, and pads and CPFs would not be allowed within 1 mi of the coast, although essential pipelines and roads may still occur. In addition, Alternative C would impose greater timing restrictions on human activity within the PCH post calving habitat area than Alternative B. Demographics impacts to the PCH would be less likely than Alternative B, therefore, the intensity of subsistence impacts under Alternative C would be less than Alternative B.

Alternative D

The types of impacts under Alternative D would be the same as those described under Alternative B; however, the intensity of subsistence impacts would be substantially less under Alternative D. Less than half of the calving ground acres offered for sale under Alternative B would be offered for sale under Alternative D, and more lands would be subject to development and timing restrictions (see LS 1-10). As a result, Alternative D would be the least likely to impact calf survival and overall herd numbers of all action alternatives. Alternative D also includes greater setbacks from key subsistence drainages compared to Alternative B, including 4 mi for the Hulahula and 3 mi for the Okpilak river, which would greatly reduce impacts to subsistence in those areas, particularly during the winter months. Under

Alternative D, no pads or CPFs would be allowed within 2 mi of the coast, reducing potential impacts to coastal subsistence hunters and fishers. In addition, reclamation of infrastructure would be on ongoing process for each development area, thus lessening the duration of impacts for individual developments related to infrastructure. Alternative D would require greater design features meant to address impacts to subsistence resources and users, and greater consultation with tribal governments on design features, timing, development methods, and access. Alternative D-2 would be somewhat less likely to affect subsistence uses and resources when compared to Alternative D-1 because of the greater restrictions under Alternative D-2 on development within caribou summer habitat.

Cumulative Impacts

Past and present actions that have affected subsistence uses and resources include oil and gas development, transportation and infrastructure projects, scientific research, recreation and tourism, government hunting and harvesting regulations, and improved technologies and modernization. Oil and gas development within the program area, in combination with past, present, and reasonably foreseeable activities, and climate change, would lead to additional impacts on subsistence resources and uses, including impacts on user access, resource availability, and resource abundance, which could ultimately lead to reduced harvesting opportunities and reduced participation in subsistence activities.

Increased infrastructure and activity in and around the program area and in offshore areas could contribute to a feeling of being "boxed in" by development, particularly for Kaktovik. Concerns to this effect have been reported as early as the 1980s, when some Kaktovik hunters had already begun to refer to the Canning River as their "Berlin Wall" because of oil and gas activity to the west of it (Impact Assessment Inc. 1990). The overall area available for subsistence use will likely shrink over time due to the increasing presence of infrastructure and human activity within traditional use areas. While Kaktovik hunters will adapt, to varying extents, to the changes occurring around them and may continue to harvest resources at adequate levels, their connection to certain traditional areas may decrease over time. Increased development around Nuiqsut, including development within the program area, could also contribute to existing concerns about being surrounded by development and losing connections to traditional harvesting areas (SRB&A 2017, 2009a). The shifting of subsistence use areas away from oil and gas development will likely continue and result in long-term changes in subsistence use patterns. In addition, the increased existence of road corridors within traditional use areas could shift how residents access subsistence harvesting areas (i.e., via roads) but could also affect resource availability, particularly for those who choose not to use roads; such changes have been documented elsewhere in Alaska (SRB&A 2007, 2009b).

Development of the program area would lead to further expansion of the developed area on the North Slope, increasing the area accessible by outsiders and resulting in higher levels of oil and gas activity, including vessel, ground, and air traffic, seismic activity, gravel mining and blasting, and drilling. Harvesters may adapt to such changes by increasing the amount of effort and time spent on the land, investing in more efficient means of travel, and shifting to new subsistence areas in an effort to increase harvest success rates. Increased income (primarily expected to occur for Iñupiaq residents) could help offset some of these impacts. Nuiqsut residents have shown great adaptability to the changes occurring around them and continue to harvest subsistence resources at rates similar to before. However, despite continued harvests, residents stress that the frequent disturbances to subsistence activities, loss of connection to traditional use areas resulting from oil and gas infrastructure, and increased time and effort spent by harvesters continue to affect their overall subsistence way of life (SRB&A 2017). If

changes in resource availability occur on a larger scale (e.g., changes in migration or overall abundance of the PCH), then communities farther away, particularly those not benefitting financially from the increased development (e.g., Arctic Village and Venetie), would possibly experience greater net impacts to subsistence.

Climate change could contribute to the impacts of increased infrastructure and activity in the region by affecting the availability of subsistence resources and user access to harvesting areas. Changes in the predictability of weather conditions such as the timing of freeze-up and breakup, snowfall, storms and winds, and ice conditions can prevent individuals from traveling to subsistence use areas when resources are present in those areas or cause greater risks to safety when travel conditions are not ideal. Furthermore, changes in resource abundance resulting from climate change could contribute to changes in resource availability caused by development within and around the program area, thus further reducing their availability to subsistence users. Cumulative impacts to subsistence, in addition to impacts from climate change, could alter subsistence use areas, user access, and resource availability for Iñupiaq and Gwich'in subsistence users. Over time, changes in how residents access and use the land, and reduced opportunities for participation in subsistence harvesting, processing, distribution, and celebrations resulting from decreased harvests, could have negative effects to culture by weakening social ties and knowledge of cultural traditions. Thus far, communities on the North Slope have adapted to the changes occurring around them and maintained a strong subsistence identity. The continued maintenance of subsistence traditions will depend on the continued availability of subsistence resources and the continued ability of subsistence users to access resources, particularly if there are changes in resource abundance, distribution, or migration.

Alternatives that allow the greatest amount of land to be developed and which have fewer timing and other restrictions would provide the greatest contribution to cumulative effects on subsistence uses and resources because they would have a greater effect on resource availability, resource abundance, and user access. Thus, Alternative B would have the largest contribution to cumulative effects on subsistence uses and resources, while Alternative D-2 would contribute the least to cumulative effects on subsistence uses and resources.

3.4.4 Sociocultural Systems

Affected Environment

This section describes the affected environment for sociocultural systems potentially affected by the leasing program. In particular, the program could affect sociocultural systems among the indigenous Iñupiaq and Gwich'in peoples who use the program area, who have cultural ties to the program area, who use resources that cross through the program area, or who could experience social or economic changes associated with the leasing program.

This section provides an overview of sociocultural systems among the Iñupiat and Gwich'in peoples, including history, social/political organization, the mixed cash/subsistence economy, and belief systems, with an emphasis on the communities closest to the program area: Nuiqsut, Kaktovik, Arctic Village, and Venetie. Additional associated information relevant to sociocultural systems is given in **Sections 3.4.2**, Cultural Resources, **3.4.3**, Subsistence Uses and Resources, **3.4.10**, Economy, and **3.4.11**, Public Health.

History

Iñupiaq

Prehistory and history associated with the program area is described in USFWS (2015). Kaktovik and Nuiqsut are the two Iñupiaq communities closest to the program area. Kaktovik, which had been an important trading center for centuries, was permanently settled by Euro-Americans following the establishment of a trading post by Tom Gordon in 1923 (Wentworth 1979). The trading post was closed in 1942; however, Iñupiat were drawn back to Kaktovik for jobs when preparations for the DEW Line site at Barter Island began in the mid-1940s.

In 1951, a Bureau of Indian Affairs school was built in the thrice-moved village, which—along with the draw for wage labor—led to permanent settlement and the establishment of the modern community of Kaktovik (Impact Assessment Inc. 1990a; Mikow 2010). In 1973, after the 1970 passage of the Alaska Native Claims Settlement Act (ANCSA), 27 families from Utqiaġvik permanently resettled in Nuiqsut to live in a more traditional manner (Brown 1979). Many of those who moved there had family connections to the area (Impact Assessment Inc. 1990b). The families selected the present location of Nuiqsut for its centrality to subsistence resources and ease of access to harvest locations inland, along the river and delta, and in the ocean (Brown 1979).

Gwich'in

Prehistory and history associated with the program area is described in USFWS (2015). Overall, compared to other indigenous groups, European presence was limited in Gwich'in territory throughout the 1800s and early 1900s. As such, the traditional subsistence lifestyle, including a continued reliance on hunting and fishing as a primary source of food and as a primary basis for Gwich'in belief systems, was substantially maintained until World War II (Caulfield 1983).

A severe decline in caribou populations in the Yukon Flats area in the late 1930s and 1940s may have precipitated the need for the Gwich'in people to adapt to a more cash-based economy (Caulfield 1983). The US established several Native reservations in Alaska following the inclusion of Alaska in the Indian Reorganization Act (IRA) of 1936. The Chandalar Native Reserve included the Gwich'in people of Arctic Village and Venetie. It was during this period that the Gwich'in people made a final transition to permanent settlements (Inoue 2004). The early 1960s saw the creation of the Arctic National Wildlife Refuge, which included lands traditionally used by the Gwich'in people.

Social and Political Organization

Iñupiaq

Iñupiaq social organization traditionally revolved around the family and extended kin, in addition to trading partnerships and friendships (Hall 1984). The social and political organization of Iñupiaq societies revolved around the family; however, one role in particular—the umialik—exerted the most political influence. In coastal communities, an umialik would be responsible for organizing hunts for marine mammals, such as whales, and also managed a crew that he enlisted during these hunting activities (Chance 1990; Burch 1980).

Following Euro-American contact in the second half of the nineteenth century, the social and political organization of the Iñupiat changed. These changes were a result of various factors, including compulsory education. This led to the following (Chance 1990):

- Centralization of people into permanent villages
- Introduction of modern technologies, which altered residents' methods for harvesting and processing subsistence foods
- Introduction of a cash economy
- Introduction of Christianity
- Incorporation of the Iñupiat into new systems of laws and governing systems

Alaska Natives began forming village councils, which were reorganized under the Indian Reorganization Act. The ANCSA was passed in 1971 and resulted in the formation of regional and village corporations; NSB formed in 1972.

Despite the changes in social and political organization over time, the core of Iñupiaq social organization is similar on the North Slope today, in that it encompasses not only households and families, but also wider networks of kinship and friends and individual family groups that depend on the extended family for support. The sharing and exchange of subsistence resources strengthen these kinship ties. The Iñupiat continue to uphold certain traditional social roles, such as those of the whaling captains, whaling crew members, and whaling captains' wives. Similar to the traditional role of the umialiks, today's whaling captains play a key role in Iñupiaq society and political life. Six North Slope communities, including Kaktovik and Nuiqsut, are members of the Alaska Eskimo Whaling Commission and have local whaling captains associations.

The program area is in the NSB, which has permit authority relevant to the leasing program. Other federal and state agencies, including the USFWS, which is the land manager for all nonnative land in the program area, also have permit authority related to the program. Many residents of the eight permanent North Slope communities are members of the regional federally recognized tribe Iñupiat Community of the Arctic Slope (ICAS) and are shareholders in the Arctic Slope Regional Corporation (ASRC).

The NSB and ASRC not only provide employment but also revenue and economic opportunities throughout the region. The NSB has taxing authority on all lands throughout the North Slope, while the ASRC and other village corporations generate revenue through leasing their lands and providing oilfield services. As oil and gas development has moved closer to Nuiqsut, the community's Kuukpik Corporation has generated revenue, provided employment opportunities, and become a key player in advocating for environmentally and socially responsible development on the North Slope; thus, North Slope communities have shared in the financial gains associated with petroleum development since the 1970s.

Community institutions in Kaktovik include the City of Kaktovik, the Native Village of Kaktovik (a federally recognized tribe), and the Kaktovik Iñupiat Corporation. In addition, several subsistence-related organizations are in Nuiqsut, including the Kuukpik Subsistence Oversight Panel, Inc. (KSOPI), which was established in 1996 in response to development of the Alpine oilfield.

<u>Gwich'in</u>

The Gwich'in people are one of several Athabascan cultural groups in Alaska. Traditional social and political organization of the Athabascans was the people who lived in small autonomous bands composed of closely related kinsmen. Kinship affiliations were extensive, reaching beyond the immediate group or band and providing people with a network of relationships from which to seek assistance in

time of need. The Gwich'in people had a kinship system based on matrilineal[26] clans organized into moieties[27] (McKennan 1959; Guédon 1974; Haynes and Simeone 2007). Political organization was decentralized and informal, with most decisions affecting the group reached by consensus. In some cases, a leader attained a particular status that enabled him to attract a following. Among many Athabascans, such leaders were known as "rich men" (De Laguna and McClellan 1981; Clark 1981). Today, Gwich'in people continue to recognize certain highly respected individuals with the title of "chief."

Beginning in the mid- to late 1800s, the fur trade, mineral development, the church, and government all worked to undermine traditional kinship patterns by emphasizing the individual over the group. Europeans and Americans also brought new social values, laws, and economic models that undermined and even banned the traditional practices that supported the existing social structure and hierarchy. The Episcopal Church, for example, attempted to stop the ceremonial potlatch,[28] because missionaries believed it was wasteful (Simeone 1992). In doing so, the church failed to understand the importance of Athabascan reciprocity by sharing wealth and maintaining physical and social well-being. The church's attempted ban threatened Athabascan social and political organization and the people's survival.

Despite the various changes to social and political organization over time, much of the traditional Gwich'in social and political structure remains intact. Subsistence remains central to their identity. They view their primary cultural tradition as living with the caribou—referring to themselves as the caribou people—with an emphasis on the reciprocal nature of their relationship with this important resource. Many traditional roles and practices related to hunting, fishing, and gathering remain in place today, and residents still observe traditional rituals and feasts, including the potlatch. Similar to the Iñupiat, sharing is central to maintaining social and kinship ties among the Gwich'in people. Modern Gwich'in leadership also mirrors traditional leadership models, with village councils providing both moral and legal guidance to tribal members (Dinero 2005).

After passage of ANCSA, residents of the formerly established Chandalar Native Reservation, including those from Arctic Village and Venetie, elected to take possession of their former lands (approximately 1.8 million acres of land), rather than transform into economic corporate entities as many other Alaska Natives had done (Inoue 2004; Alaska Department of Commerce 2018). An additional 3.4 million acres north and west of the original reservation were later added, based on earlier petitions. Venetie and Arctic Village thus established the Venetie Indian Reserve which is managed jointly under the Native Village of Venetie Tribal Government. Unlike many Alaska Native communities, Arctic Village and Venetie are not enrolled in a regional Native corporation and do not have ANSCA village corporations.

Since interest in developing the Arctic Refuge began in the 1980s, the Gwich'in people—particularly the Gwich'in of Arctic Village and Venetie—have taken various legal and political actions to prevent such development. Based primarily in concerns about impacts on caribou who calve in the Coastal Plain and subsequent impacts on Gwich'in cultural survival, their opposition has led to a strong activist identity. Many of their people wish to protect their traditional lifestyle centered on the Porcupine caribou herd. In 1988, the first of many Gwich'in gatherings was held in Arctic Village to discuss the potential for

[26] Ancestral lineage traced through female relatives
[27] Social organization divided into two parts
[28] A ceremonial feast, where participants part with or destroy possessions, in a display of wealth or prestige.

development in the Arctic Refuge. Out of this meeting the Gwich'in Steering Committee was established, whose stated goal was to "establish Gwich'in cultural survival as a major issue in the debate over oil development in the Arctic National Wildlife Refuge" (Inoue 2004). Meeting attendees included over 500 Gwich'in people from both Alaska and Canada.

Community institutions in Arctic Village include the Arctic Village Traditional Council and the Neets'ai Corporation (the local village corporation). Community institutions in Venetie include the Venetie Village Council. Both Arctic Village and Venetie are members of the Native Village of Venetie Tribal Government, the Council of Athabascan Tribal Governments, and the Tanana Chiefs Conference (Alaska Department of Commerce 2018). Both communities are on the Gwich'in Steering Committee.

Mixed Cash/Subsistence Economy

<u>Iñupiaq</u>

The Iñupiat traditionally participated in an economy that relied on subsistence resources and used trade to acquire goods not readily available in their immediate area. The concept of wealth was based on the number or amount of accumulated foods and goods; those with the most material possessions were the wealthiest. Among the Tagiugmiut Iñupiat ("people of the sea"), the umialik was often held by the wealthiest person, who needed to have a surplus of food and property to outfit a whaling crew.

Both the Tagiugmiut and Nunamiut Iñupiat ("people of the land") participated in extended trade networks that included both formalized and less formal modes of trading (Spencer 1959). Their trade was not limited to other Iñupiat, and they also traded with Athabascan peoples farther south, often through established trade fairs, such as those at Nigliq and on Barter Island.

The economy of the North Slope underwent major changes beginning in the mid-nineteenth century. This is when commercial whaling introduced a new type of economy to the Iñupiat, followed by other economic developments, such as reindeer herding and fur trapping. The development of petroleum reserves began in the 1940s and is still the driving force of the economy on the North Slope.

Today, the Iñupiat of the North Slope continue to rely on subsistence resources, while participating in the cash economy. Like other communities on the North Slope, Nuiqsut and Kaktovik have a mixed, subsistence-market economy (Walker and Wolfe 1987), where families invest money into small-scale, efficient technologies to harvest wild foods. Native corporation dividends rely heavily on oil and gas development, and many residents use their dividends as investments into their subsistence way of life. These investments can include gill nets, motorized skiffs, and snowmachines used to conduct subsistence activities. They are not oriented toward sales or profits but are focused on meeting the self-limiting needs of families and small communities.

The trade networks that characterized the traditional subsistence economy of the Tagiugmiut and Nunamiut continue today, exchanging subsistence marine mammal products for terrestrial resource products. In fact, sharing subsistence foods with other communities and regions is a major component of the mixed economy, and it has been facilitated by advancements in rural transportation and technology.

<u>Gwich'in</u>

Before Euro-American contact, Northern Athabascans were hunters and gatherers who moved seasonally throughout the year within reasonably well-defined territories to harvest fish, wildlife, and a

variety of plants. The pre-contact Athabascan economy revolved around subsistence resources, and they traded to acquire goods not readily available in their immediate area. The Gwich'in subsistence economy was focused primarily on harvests of caribou, but also fish, such as whitefish, and other resources.

Up until the discovery of gold in the Gwich'in territories in the 1890s (1893 at Birch Creek), the subsistence economy was largely intact, and Native people remained independent and essential to the Euro-American fur-trading economy (Mishler and Simeone 2004). Over time, many in the region focused increasingly on harvesting furs over traditional subsistence activities in order to accumulate capital for trade. This in turn prompted a shift to a more stable village life, which opened the door for further changes to the traditional economy.

Beginning with the gold rush and especially by the start of World War II, the Gwich'in people were presented with alternative ways of living, which were not oriented toward a life wholly dependent on the land. A living based on hunting, fishing, and trapping became only one of several choices; subsistence became a component of a "mixed, subsistence-market economy" (Walker and Wolfe 1987), rather than supplying the entire economy as it once did.

The Gwich'in people of Arctic Village and Venetie have a deep relationship with the land they occupy and the resources they use. In contrast to the Iñupiaq villages farther north, there is little economic development in the Gwich'in area and few opportunities for local employment (Kofinas et al. 2016). In most cases, seasonal employment, rather than full-time or permanent employment, directly supports the subsistence activities of individuals. They, in turn, share the harvest with residents, as well as those who live in villages and regional centers, including Fairbanks and Anchorage (Caulfield 1983). The relative lack of cash to support subsistence activities may make these communities more vulnerable to changes in the availability of resources, such as caribou. This is because residents have less wherewithal to travel great distances in search of subsistence resources or to purchase alternative foods that are less desirable.

Belief Systems

<u>Iñupiaq</u>

Traditional Iñupiaq belief systems consisted of two religious elements: hunting ritual and shamanism. These elements were similar to belief systems held by other Eskimo populations (Spencer 1984). Iñupiaq beliefs originally revolved around a system oriented to the environment and its animals.

Following proper hunting rituals was necessary to ensure a successful harvest. These rituals included actions taken before the hunt to avoid offending the animals and rituals taken after an animal was taken. Examples of this are offering freshwater to sea mammals, giving gifts to trapped land animals, and cutting the throat or opening the brain pan to free the soul (Spencer 1984). The more important the resource was to the community, the more elaborate and extensive the rituals and ceremonies associated with it. One of the most important ceremonies on the coast was the Whale Feast (Nalukataq); its inland counterpart was the caribou festival (Spencer 1959). The Messenger Feast (Kivgiq), which has seen a revival on the North Slope in recent years, was an opportunity for Iñupiat from across the region to come together for trading and sharing.

Shamanism was a second key component to Iñupiaq belief systems. Shamans played specific roles relating to illness, predicting weather, finding lost items, foretelling the future, and speaking to the dead (Spencer 1984; Hall 1984). Despite the existence of shamans in traditional Iñupiaq society, the traditional belief

system was largely fatalistic (Chance 1990); in other words, Iñupiat believed that powers beyond their control governed their environment. Their rituals and shamans, while having some influence, might prove ineffective despite their efforts.

Belief systems among the Iñupiat of the North Slope were largely unchanged before 1890, even though the region had experienced a number of changes from the whaling industry and various exploratory expeditions. After 1890, a number of Christian missions were established in the region, and rapid changes to Iñupiaq belief systems began.

The introduction of Christianity also introduced a rippling effect of changes that altered a number of Iñupiaq cultural values and traditions, particularly those surrounding housing, morality, subsistence, and social organization; however, despite these changes, the Iñupiat of the North Slope today retain a strong cultural identity associated with traditional subsistence hunting and harvesting patterns, and many traditional belief systems are strongly held and celebrated. Contemporary Iñupiaq values strongly mirror traditional ones, and include cooperation, hunting traditions, family and kinship, respect for nature, sharing, and spirituality (NSB 2018).

Coastal North Slope communities such as Kaktovik and Nuiqsut maintain a strong maritime culture that centers on the bowhead whale hunt and emphasizes cooperation, participation in hunting traditions, and sharing. Whaling captains continue to have central roles as leaders in their communities and across the region. To the Iñupiat, protecting the land and water is essential to maintaining a culture that relies on the harvest of wild resources. This includes maintaining lands that are untouched by industry and where residents can conduct subsistence activities in relative solitude.

For the program area and greater territory of the Kaktovikmiut (people of Kaktovik), this belief in the duty of the Iñupiat to protect their homeland and to serve as stewards of the land and sea is described in the City of Kaktovik's document "In This Place" and is succinctly expressed in the opening general statement as follows: "We the Kaktovikmuit, the people of Kaktovik, are principally Iñupiat Eskimo, Native people of the Arctic Slope, the country that drains northward from the Brooks Range to the Arctic Ocean. We use and occupy this country, its associated waters, and the sea; and have claimed it since time immemorial by virtue both of aboriginal rights and our continued and undisplaced use and occupance." (City of Kaktovik and Karl E. Francis & Associates 1991: 1)

<u>Gwich'in</u>

The Gwich'in people have a spiritual relationship with their environment that is integral to their cultural system. Before the gradual adoption of Christian beliefs and Western values beginning in the mid-nineteenth century, the Gwich'in followed a loosely organized, animistic religion. It centered on a reciprocal relationship between humans and the rest of the natural world, immortality through reincarnation, and a variety of usually malevolent spirits and magical creatures (Slobodin 1981; VanStone 1974).

Athabascan belief systems had a holistic view of nature, in that no distinction existed between humans and animals, and everything in nature was considered sentient or to have a spiritual essence. Plants and animals were not objects governed by instinct but social beings with a spiritual potency controlled by powerful sprits or guardians. There was a concept of the Supreme Being, but it was distant from human affairs, took no particular form, and was not approached through an intermediary (Sullivan 1942). The

key cosmological figures were Raven, who was the world maker, but inscrutable and imperfect; the transformer; and the Traveler, who reordered the relationship between humans and animals so that animals became the prey of humans (McKennan 1959; Wright 1977; Krupa 1999; Haynes and Simeone 2007).

Christian missionaries of various denominations had considerable effect on the traditional Gwich'in belief system and used an intense five-fold strategy of building, speaking, teaching, healing, and traveling to undercut traditional ways of life and to provide what were perceived as appropriate Christian alternatives (Fienup-Riordan 1992). Early in the twentieth century the Episcopal Church attempted to abolish the potlatch, but was rebuffed, and today the potlatch is stronger than ever and remains a significant part of Native identity. Others fused Christianity and traditional beliefs into a single belief system as some of the Dena'ina had done with the Russian Orthodoxy and the Iñupiat had done with the Anglicans and Presbyterians. Lastly, some individual Athabascans saw the presence of missionaries as a good thing, saving individuals from alcoholism, while others saw a bias against Native people and their traditional ways (Reckord 1979).

The proper relationship between humans and animals is a central tenet of the traditional belief system. Animals were not only a source of food but powerful spiritual beings that must be treated with respect. Animals and humans shared an essence of personhood; both were sentient and volitional. They acted on their own values and choices and shared a fundamental organization in that each had a soul, a language, a family, and similar emotional characteristics, including anger and a desire for vengeance.

Animals and humans existed in a reciprocal relationship in which humans needed to kill animals to survive and animals desired to give themselves as food, but only on the condition that humans treated them with respect. The importance of reciprocity extends to humans as well—failure to share resources with others is not only frowned on socially but is considered a violation of a kind of social contract with game animals, threatening the success of future harvests (Caulfield 1983).

The importance of reciprocity in human and animal relationships is evident in contemporary Gwich'in culture through their continued identification as the caribou people, their continued observance of certain customary laws, the strong belief in the sacredness of places like the Coastal Plain, due to its integral connection to caribou calving and migratory bird nesting grounds, and the continued practice of traditional rituals, such as the potlatch.

Direct and Indirect Impacts

This section describes the potential direct and indirect impacts of the proposed oil and gas leasing program on sociocultural systems. As described in the previous section, Iñupiaq and Gwich'in sociocultural systems are based on social and kinship ties, subsistence harvesting activities, and a deep connection to the land and its resources. Oil and gas development within the program area has the potential to affect sociocultural systems by introducing changes to traditional subsistence lands and resources, the social, health, and cultural environment, and local and regional economies.

Alternative A

Under Alternative A, no oil and gas leasing program would take place within the program area. Sociocultural systems among the Iñupiat and Gwich'in would remain unaffected by additional oil and gas development and the associated economic, biological, and social changes. Iñupiaq and Gwich'in

sociocultural systems would likely continue to evolve as a result of existing forces of change such as increased modernization and technology; development and associated activities (e.g., oil and gas development, researchers) outside the coastal plain; infrastructure and transportation projects; changes to land status; environmental changes; and increased outsiders within traditional use areas. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

This section discusses impacts to sociocultural systems which are common to all alternatives. The primary factors which may result in impacts to sociocultural systems include: 1) changes in income and employment levels, 2) changes in available technologies, 3) disruptions to subsistence activities and uses, 4) influx of non-resident temporary workers associated with the project, and 5) influx of outsiders coming into the study communities.

<u>Changes in Income and Employment Levels</u>

Increased income and employment levels—most likely to occur among the Iñupiat of the North Slope—could affect sociocultural systems by changing the socioeconomic status of certain community members; reducing the time spent by certain individuals on harvesting subsistence resources and thus affecting social ties within the community; and increasing the amount of cash available to engage in subsistence activities and support subsistence-related equipment and infrastructure. An influx of cash into a small, rural community can have both positive and negative impacts on sociocultural systems. Traditional Iñupiaq and Gwich'in societies are based on social and kinship ties which are established and strengthened through the procurement, processing, consumption, and sharing of subsistence resources (see Affected Environment, above).

Certain households or individuals play a particularly important role in the harvesting of subsistence resources and distribution of those resources to households and individuals who are unable to hunt or harvest for themselves. These super-harvester households have been identified through previous ADFG research which has found that 30 percent of households generally harvest 70 percent of the total community harvest (Wolfe 2004). An increase in employment opportunities may result in some of these households shifting from their role as super harvesters to high earning households, as they lack the time to engage in subsistence activities as frequently as they once did. This could result in weakening or shifting of certain social ties within the community. While this could cause short-term social stresses within a community, Kofinas et al. (2016) notes that the role of super-harvester households often changes over time, and that communities are in fact quite resilient to these changes. In addition, the roles of super-harvester household and high-earning household are not mutually exclusive; in fact, Kofinas et al. (2016) found that many super-harvester households also tend to have high income. Thus, an increase in income and employment may increase opportunities for subsistence harvesting. That said, a sudden and substantial increase in employment and income may cause a more dramatic shift in the role of super-harvester households in the community, and it may take longer for the community to adjust to the changes. During the initial period of development, there may be a lack of super-harvester households as new roles are established. As a result, distribution of subsistence foods throughout the community could temporarily decline.

In addition to super-harvester households, high earning households also play an important role in the subsistence economy as they often provide financial support to subsistence harvesters in the community as well as in their own households. As noted above, super-harvester households are often also high-earning households. An increase in employment and income resulting from the proposed oil and gas leasing program could therefore have positive effects on social ties once community roles are established. However, increased income opportunities within a community can also cause greater income disparities between households, especially if certain households are not shareholders in the village or regional corporations. Such disparities can affect social relations and leadership roles within a community. In general, an increase in employment opportunities could strengthen resident's resolve to remain in their home communities rather than moving out of their community in search of employment. Subsistence activities have been shown to persist despite increased income and wage employment, which demonstrates that the importance of subsistence is not limited to its nutritional benefits alone (Kruse 1991).

Changes in income and employment would have the most direct impact on the Iñupiaq community of Kaktovik and may also extend to other Iñupiaq communities, although direct participation in oil and gas activities by North Slope residents would be relatively limited (**Section 3.4.10**, Economy). Kaktovik is closest to the program area, and therefore Kaktovik residents are most likely to obtain employment associated with development and support activities within the program area. In addition, residents of Kaktovik will likely see greater economic benefits associated with the oil and gas leasing program as shareholders of the village corporation (KIC). The City of Kaktovik may also benefit from bed tax revenues associated with increased visitors to the community; an increase in tax revenue could benefit sociocultural systems by contributing to community improvements (**Section 3.4.10**, Economy).

On a regional scale, Iñupiat communities across the North Slope may see economic benefits as shareholders of the Arctic Slope Regional Corporation and through NSB revenues, and they may also be exposed to a greater number of employment opportunities. By contrast, Gwich'in residents would likely see only modest economic benefits associated with profit sharing from ASRC to their regional corporation (Doyon, Inc.). The Gwich'in communities closest to the program area – Arctic Village and Venetie – do not belong to Doyon and do not have village corporations holding land within the program area and therefore would see limited economic benefit associated with the proposed oil and gas leasing program (See **Section 3.4.10,** Economy). The comparative lack of economic benefits for the Gwich'in, especially the communities of Arctic Village and Venetie, could make those communities more vulnerable to social impacts, particularly those associated with disruption of subsistence activities. Without the economic benefits of development, communities are more vulnerable to its impacts and less able to adapt to environmental and social changes resulting from the development.

<u>Changes in Available Technologies</u>

Increased income and employment could also lead to increased access to technologies such as subsistence equipment and fuel. Access to such technologies could aid subsistence users in accessing subsistence harvesting areas, particularly if development activities result in subsistence users having to travel farther or spend longer to find and harvest subsistence resources. Communities in close proximity to oil and gas development areas may also eventually have greater access to high speed Internet and strong cellular reception. In recent years, greater use of and access to cell phones and social media has shifted, in many ways, how residents within and between communities communicate with one another. In some ways, it has expanded social ties by facilitating connections across regions of

Alaska and encouraged the establishment of trading relationships. Greater access to transportation and shipping options can also have a positive impact on sharing networks and the ability to bring goods directly into the community. Such changes would be most likely to occur for Kaktovik because of its proximity to the program area.

Disruptions to Subsistence Activities and Uses

Disruptions to subsistence activities associated with the oil and gas leasing program could indirectly affect social cohesion. As noted above, increased income and employment levels could change social ties and organization by causing certain individuals and households to shift in to new, non-subsistence roles. In addition, to the extent that development activities within the program area disrupt subsistence activities or cause reduced availability of certain resources to subsistence harvesters, residents may either experience reduced harvests of subsistence foods, or they may spend greater time, effort, and expense in pursuit of subsistence resources (see **Section 3.4.3**, Subsistence Uses and Resources). Impacts on subsistence resource availability would likely occur throughout the life of the leasing program. Nuiqsut residents have reported impacts on resource availability associated with nearby developments but continue to harvest resources at levels similar to before; however, continued harvests do not imply an absence of impacts. Residents report adapting to changes in resource availability by shifting to new hunting areas, spending more effort and time on the land, or changing hunting methods (e.g., hunting caribou along newly introduced road corridors).

An inability to harvest adequate subsistence resources can have negative social consequences for a community. Decreased harvests of subsistence resources—particularly key resources such as bowhead whales (for the Iñupiat) and caribou (for the Iñupiat and Gwich'in)—results in decreased opportunities for participation in activities such as processing, consuming, and sharing subsistence foods; and participation in culturally important feasts and festivals; all of which are important in maintaining and strengthening social and cultural ties within the community. The inability of subsistence harvesters to provide for their community can also have negative social and health/nutritional consequences (**Section 3.4.11**, Public Health). Residents have reported that during times of reduced harvest success, they have witnessed increased social problems such as drug and alcohol use, particularly among younger subsistence hunters (SRB&A 2009). Increased access to project roads, introduction of new infrastructure within traditional use areas, and associated changes in subsistence travel routes and harvesting patterns could increase the risk of injuries and accidents during subsistence activities, causing negative social effects (**Section 3.4.11**, Public Health). Finally, decreased use of certain traditional areas, either due to changes in resource availability or changes in user access, can result in fewer opportunities for residents to pass on traditional knowledge about those places, weakening the cultural associations residents have with the land. Impacts to subsistence would occur to varying extents for different communities. Direct impacts to subsistence activities would likely be greatest for Kaktovik; however, indirect impacts on resource availability such as caribou could occur for Nuiqsut, Arctic Village, Venetie, and other communities who rely on the PCH and CAH (see **Section 3.4.3**, Subsistence Uses and Resources).

Influx of Non-Resident Temporary Workers and Outsiders

Another potential source of impacts on sociocultural systems is an influx of non-resident temporary workers associated with the project into local communities and/or traditional use areas, and a general influx of outsiders into local communities associated with increased development in the region. While interactions with non-locals has become increasingly common in rural Alaskan communities, most

Iñupiaq and Gwich'in communities continue to be relatively remote and primarily Alaska Native. Interactions with non-locals can sometimes cause discomfort for local residents when non-locals do not respect or understand local traditional values and customs. Residents have expressed discomfort conducting subsistence activities when non-locals are around for fear that their traditions are misinterpreted, misunderstood, or exploited for political purposes. Such concerns have become particularly prevalent in today's climate of social media posts, viral videos, and negative online backlash (Oliver 2017). Witnessing non-locals mistreating or disrespecting the land and its resources can also have negative cultural and spiritual impacts on locals, especially if the area holds particular importance to a community. In the case of the coastal plain, the area is within Kaktovik's core subsistence harvesting area and is considered sacred ground to many Gwich'in because of its importance to the health and survival of the PCH.

The presence of temporary workers within traditional hunting areas could result in negative interactions between subsistence users and workers due to a lack of cultural understanding and respect on the part of the workers, or miscommunication of policies and procedures surrounding use of the land by local residents for hunting purposes. If the oil and gas leasing program facilitates or promotes access of outsiders into Kaktovik for reasons associated with development or otherwise, potential impacts could include increased social problems (e.g., outsiders bringing in drugs and alcohol), lack of infrastructure (e.g., lodging, transportation) to accommodate the increase in visitors, and conflicts resulting from lack of knowledge or respect of traditional values. An increase in population associated with the leasing program is not expected for Kaktovik; workers are expected to stay in work camps and return to other areas of Alaska or outside Alaska (**Section 3.4.10**, Economy). However, while an increase in permanent residency is not likely, it is possible that Kaktovik will experience an increase in visitors associated with oil and gas industry, as has happened in Nuiqsut.

Alternative B

Under Alternative B, the types of impacts on sociocultural systems would be the same as those described above (Impacts Common to All Action Alternatives). The duration of impacts would be long term for all types of impacts, although certain types of impacts, such as interactions with temporary workers, may be more frequent or intense during the exploration and construction phases of development. Impacts related to an increase in visitors to and an influx of non-resident temporary workers associated with development would occur within the general vicinity of the action area, or within the community of Kaktovik. Increases in income and employment levels may extend beyond the program area to other communities on the North Slope and possibly outside the North Slope. Changes related to disruption of subsistence activities and uses could extend outside the North Slope region to other communities who rely on the PCH and CAH herds.

Because of its proximity to the program area, the community of Kaktovik would experience the greatest intensity of both impacts and benefits associated with the proposed oil and gas leasing program. Impacts on sociocultural systems may also occur for other communities if oil and gas development in the program area results in changes to resource abundance and/or availability, particularly caribou which is a resource of major importance to the closest communities of Kaktovik, Nuiqsut, Arctic Village, and Venetie. Because of the particular spiritual and cultural importance of the coastal plain and PCH calving grounds to the people of Arctic Village and Venetie, any disruption to that herd or perceived contamination or degradation of calving grounds within the program area would have sociocultural impacts on the Gwich'in in terms of their belief systems, cultural identity, and the impact of

development within the sacred calving grounds of the PCH. Under Alternative B, 733,100 acres of calving habitat would be available for leasing.

Alternative C

The types of impacts under Alternative C would be the same as those described under Alternative B. Because fewer acres of calving grounds would be available for leasing, the intensity of sociocultural impacts related to caribou under Alternative C would be less than Alternative B.

Alternative D

The types of impacts under Alternative D would be the same as those described under Alternative B. Because fewer acres of caribou calving grounds would be available for leasing, and because more lands would be subject to development restrictions, the intensity of sociocultural impacts under Alternative D would be less than under Alternative B. In particular, Alternative D-2 would be somewhat less likely to affect sociocultural systems when compared to Alternative D-1 because of the greater restrictions under Alternative D-2 on development within caribou summer habitat.

Cumulative Impacts

Past, present, and reasonably foreseeable future activities, in combination with oil and gas development within the program area, would increase the potential for sociocultural impacts, including changes in income and employment levels, changes in available technologies, disruptions to subsistence activities and uses, and increased interactions with outsiders. Past and present actions that have affected sociocultural systems among the Iñupiat and Gwich'in include oil and gas development, onshore and offshore transportation and infrastructure projects, scientific research, increased recreation and tourism, demographic changes, changes in land status, and modernization. In addition, climate change could contribute to changes in sociocultural systems by affecting access to and abundance of subsistence resources, as well as the safety of subsistence harvesters. The proposed oil and gas leasing program, in addition to future activities, could lead to additional oil and gas development and other development and infrastructure projects.

Tensions between communities relating to differences in benefit (e.g., increased employment) and impact (e.g., disruptions to subsistence) levels could strain social ties and reduce social cohesion, while income disparities or political differences within and between communities could also contribute to social tensions between residents and community institutions. Such changes could exacerbate political differences between Iñupiat and Gwich'in communities, potentially weakening social ties. If employment opportunities increase to the extent that fewer community residents have the time to engage in subsistence activities, then overall community harvests and participation could decrease, weakening the community's identity and association with the subsistence lifestyle (see **Section 3.4.3**, Subsistence Uses and Resources) and causing reduced social cohesion and increased social problems. Alternately, increased income through employment or dividends could encourage residents to remain in their home communities and provide financial support for subsistence activities within communities, thus strengthening the mixed subsistence cash economy. A reduction in the availability of subsistence resources and/or access to subsistence use areas resulting from climate change could also have negative effects on sociocultural systems.

Increased interactions with outsiders in traditional use areas and communities has the potential to affect traditional values and belief systems over time and may also result in increased social problems if such

interactions lead to greater access to drugs and alcohol. Cumulatively, strong local economies could have positive social impacts as long as communities are able to adapt to such changes while maintaining cultural traditions and values such as subsistence, humility, respect for elders, family and kinship, and avoidance of conflict. Communities that are most likely to experience negative sociocultural impacts would be those that experience impacts on subsistence while not benefitting from increased income or employment (e.g., Arctic Village and Venetie).

Alternatives that allow the most land to be developed within the program area, and which have fewer timing and other restrictions are likely to have the greatest contribution to cumulative effects on sociocultural systems, because they would have a greater effect on subsistence uses and resources and the greatest likelihood of interactions with outsiders while likely not resulting in significantly greater regional or local economic benefits. Thus, Alternative B would have the largest contribution to cumulative effects on sociocultural systems, while Alternative D-2 would contribute the least to cumulative effects on sociocultural systems.

3.4.5 Environmental Justice

Affected Environment

Environmental justice is defined in Executive Order (EO) 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. It requires that proposed projects be evaluated for “disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.”

In 2016, the Department of the Interior released the updated Environmental Justice Strategic Plan that establishes goals, objectives, and detailed guidance for federal agencies to ensure that no racial, ethnic, cultural, or socioeconomic group disproportionately bears the negative environmental consequences of governmental programs, policies, or activities (DOI 2016).

Guidelines for evaluating the potential environmental justice effects of projects require specific identification of minority populations, when either the minority population of the affected area exceeds 50 percent, or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. These guidelines also stipulate that low-income populations in an affected area should be identified using annual statistical poverty thresholds (CEQ1997). The State of Alaska socioeconomic characteristics were selected as the reasonable general reference population for both minority populations and low-income populations.

Guidelines on environmental justice also suggest that where an agency action may affect fish, vegetation, or wildlife, that agency action may also affect subsistence patterns of consumption and indicate the potential for disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, and Indian/Alaska Native Tribes.

It is relevant to identify differential patterns of consumption of natural resources among minority populations and low-income populations, where the term means differences in rates or patterns of fish, water, vegetation or wildlife consumption among minority populations, low-income populations, or Indian/Alaska Native Tribes, compared with the general population (CEQ 1997). Subsistence patterns in the affected environment are covered in detail in **Section 3.4.3**; if subsequent analysis finds that

proposed actions relate to high and adverse impacts on subsistence, these would be of environmental justice concern as well.

The community of Kaktovik is the closest community to be potentially affected by the leasing program. Based on their identified use of subsistence resources (see **Section 3.4.3,** Subsistence Uses and Resources), the communities of Nuiqsut, Arctic Village, and Venetie are also relevant to the environmental justice analysis.

According to 2010 Census data, American Indian/Alaska Native residents of Kaktovik, Nuiqsut, Arctic Village, and Venetie (specifically Iñupiat in Kakovik and Nuiqsut and Gwich'in in Arctic Village and Venetie) account for between 87.1 and 91.6 percent of the total population of each community. The total minority[29] populations of these communities range from 90.0 to 98.2 percent of the total community population. The statewide population is 14.4 percent American Indian/Alaska Native and 35.9 percent minority overall.

The minority composition of Kaktovik, Nuiqsut, Arctic Village, and Venetie, compared with Alaska, is shown in **Table K-2** in **Appendix K**, Environmental Justice. Based on 2010 census data, the minority population in all four communities is well above the 50 percent threshold (and meaningfully greater than the general reference population), as specified in the CEQ guidelines. Based on minority population criteria, these communities should be considered for potential environmental justice issues when evaluating the effects of the action.

Additionally, as shown in **Table K-1** in **Appendix K,** Environmental Justice, while the proportion of low-income residents in Kaktovik and Nuiqsut is well below that seen in the general population of Alaska, the low-income population components of Arctic Village and Venetie are meaningfully greater than that of the general population of Alaska (about 4.6 and 5.3 times higher, respectively, with roughly half the residents in both communities living below the poverty level). Finally, each of these four communities is predominantly Alaska Native, with associated Tribal entities. As a result, each community meets more than one criteria for potential impacts of the action to be of environmental justice concern.

As noted in **Section 3.4.10**, Economy, residents of the North Slope Borough could experience a range of direct or indirect beneficial economic impacts from the action. As shown in **Tables K-1** and **K-2 (Appendix K**, Environmental Justice), while the low-income proportion of the North Slope Borough's overall population is roughly equivalent to that of Alaska, the minority proportion of the North Slope Borough's population is meaningfully greater than that of the state. The result is that there is the potential for beneficial project impacts to disproportionately accrue to a population that is otherwise of environmental justice concern.

The CEQ guidance on environmental justice under NEPA (CEQ 1997) directs federal agencies to apply CEQ guidance with flexibility. It says to consider them as a point of departure, rather than conclusive direction in applying the terms of the executive order on environmental justice. Following this guidance,

[29] For the purposes of environmental justice analysis, a minority population includes all persons other than those individuals who self-identify in the census as both White and non-Hispanic or Latino.

analyses of potential impacts should be highly sensitive to the history or circumstances of a given community or population.

As noted in the sociocultural systems and economy affected environment discussions (**Section 3.4.4** and **3.4.10**, respectively), the different histories and circumstances of the relevant Iñupiat and Gwich'in people, such as outcomes under the ANCSA and the formation of the NSB, among other factors, are likely to not only result in a differential distribution of potential impacts from the action but also to affect the vulnerability and resilience relative to potential adverse impacts.

As noted in **Section 3.4.4**, Sociocultural Systems, social and cultural values related to subsistence resources and activities represent another key area of potential environmental justice concern. For example, primary concerns of the Gwich'in expressed during public scoping were the sacredness of the caribou calving and bird nesting grounds in the program area. This is in addition to more direct potential impacts on the reliability of the Porcupine caribou herd and waterfowl annual migrations through Gwich'in territory. In other words, potential environmental justice concerns related to potential adverse impacts on subsistence resources extend well beyond the immediate program area and encompass the social and cultural value of subsistence resources, as described in ANILCA, as well as the value of direct reliance on these resources for physical sustenance.

Direct and Indirect Impacts

This analysis of impacts related to environmental justice considers if implementation of the proposed alternatives would result in disproportionately high and adverse environmental or human health effects to the communities of Kaktovik, Nuiqsut, Arctic Village, and/or Venetie. These communities meet the demographic characteristics to be qualified as minority populations (and the latter two as low-income populations) and require evaluation for disproportionate impacts under environmental justice.

EO 12898 directs federal agencies, to the greatest extent practicable and permitted by law, to achieve environmental justice by identifying and addressing disproportionately high and adverse human health or environmental effects of proposed federal actions on minority and low-income populations. The NEPA analysis of environmental justice is also informed by CEQ guidance, as follows:

> Under NEPA, the identification of a disproportionately high and adverse human health or environmental effect on a low-income population, minority population, or Indian [or Alaska Native] tribe does not preclude a proposed agency action from going forward, nor does it necessarily compel a conclusion that a proposed action is environmentally unsatisfactory. Rather, the identification of such an effect should heighten agency attention to alternatives (including alternative sites), mitigation strategies, monitoring needs, and preferences expressed by the affected community or population (CEQ 1997).

Federal agencies also are required to give affected communities opportunities to provide input into the environmental review process, including the identification of mitigation measures. The BLM has assured meaningful community representation in the process by holding public meetings in the communities of Kaktovik, Arctic Village, and Venetie, among others; coordinating directly with federally recognized tribal governments in compliance with EO 13175 and BLM's Tribal Consultation policy, which has resulted in government-to-government meetings with relevant entities in Kaktovik, Arctic Village, and Venetie, among others, and ANCSA corporation consultation meetings with the Kaktovik Inupiat Corporation

and the Arctic Slope Regional Corporation, among others; and having several tribal governments sign on for participation as cooperating agencies, including the Native Village of Kaktovik, Arctic Village Council, Venetie Village Council, and the Native Village of Venetie Tribal Government.

Following CEQ (1997) guidance on evaluating environmental justice under NEPA, the analysis should recognize if the question of whether agency action raises environmental justice issues is highly sensitive to the history or circumstances of a particular community or population. The historical context within which environmental justice issues are considered is presented in the sociocultural systems analysis (**Section 3.4.4**). BLM recognizes the interrelated cultural, social, occupational, historical, or economic factors that are likely to amplify the natural and physical environmental effects of the proposed action. CEQ guidance also directs the BLM to consider any multiple, or cumulative effects, to human health and the environment even if certain effects are not within the control or subject to the discretion of the agency (CEQ 1997).

The BLM therefore considered the following factors in determining whether the environmental effects of proposed action will be disproportionately high and adverse: whether there is or will be an impact on the natural environment that significantly and adversely affects Alaska Native residents of Kaktovik, Nuiqsut, Arctic Village, or Venetie. Such effects may include subsistence, sociocultural, economic, or public health and safety impacts to residents when those impacts are interrelated to impacts on the natural and physical environment. Potential impacts for these resources are discussed in **Section 3.4.3**, Subsistence Uses and Resources, **Section 3.4.4**, Sociocultural Systems, **Section 3.4.10,** Economy, and **Section 3.4.11**, Public Health and are not recapitulated in this section beyond brief summaries. This environmental justice analysis also considers that some Inupiaq entities and Iñupiat individuals as shareholders in ANCSA corporations would benefit economically from the proposed action.

Alternative A

No environmental justice concerns are evident in the analysis of Alternative A. Specifically, subsistence uses and sociocultural systems among the Iñupiaq and Gwich'in peoples would be unaffected by oil and gas development within the program area. Iñupiaq and Gwich'in sociocultural systems would likely continue to evolve due to existing forces of change such as increased modernization and technology; development and associated activities (e.g., oil and gas development, researchers) outside the coastal plain; infrastructure and transportation projects; changes to land status; environmental changes; and increased outsiders within traditional use areas. The economic conditions and the local, regional, and state level are expected to continue. Additionally, there would be no impacts to public health and safety associated with Alternative A.

Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

For all action alternatives, potential environmental justice impacts would derive from disproportionately high and adverse human health or environmental effects identified in other resource area analyses that would accrue to minority populations, low-income populations, and/or Alaska Native tribal entities.

Impacts identified as subsistence, sociocultural, and public health and safety impacts are largely, if not exclusively, also of environmental justice concern.

In the case of subsistence and sociocultural analyses, identified potential adverse effects are concentrated in communities with largely Alaska Native populations (Kaktovik, Nuiqsut, Arctic Village, and Venetie), all of which have affiliated tribal entities and, in the case of the North Slope communities, affiliated Alaska Native regional and local corporations with substantial resident shareholder populations. In the case of potential public health and safety impacts, nearly all of the identified potential adverse effects are concentrated in Kaktovik as the community closest to likely future development. In the case of economic impacts, few potential adverse impacts are identified, but potential localized beneficial impacts are noted as most likely to accrue to residents of Kaktovik and other NSB communities, both in terms of governmental revenues and in terms of returns to resident Alaska Native corporation shareholders.

<u>Subsistence Uses and Resources</u>

The primary factors which may result in impacts to subsistence resources and uses include: 1) noise, traffic, and human activity, 2) infrastructure (including physical barriers), 3) contamination, 4) legal or regulatory barriers, and 5) increased employment or income/revenue. These factors could affect resource availability, resource abundance, and user access for residents of the study communities. In all cases, development activities have the potential to affect subsistence uses of resources of major importance for the subsistence study communities. Kaktovik is the primary user of the program area and would therefore be most likely to experience direct impacts associated with development activities. Nuiqsut has the potential to experience direct and indirect impacts associated with harvests of marine mammals (e.g., bowhead whale) and indirect impacts associated with harvests of caribou, waterfowl, and fish. Arctic Village, Venetie, and other communities whose residents subsist in part on the PCH and CAH, have the potential to experience indirect impacts associated with caribou and, to a lesser extent, waterfowl. Impacts related to an increase in employment rates or income are most likely for the community of Kaktovik but could extend to other communities on the North Slope. Overall, development within the program area could have lasting effects on cultural practices, values, and beliefs through its impacts on subsistence.

<u>Sociocultural Systems</u>

The primary factors which may result in impacts to sociocultural systems include: 1) changes in income and employment levels, 2) changes in available technologies, 3) disruptions to subsistence activities and uses, 4) influx of non-resident temporary workers associated with the project, and 5) influx of outsiders coming into the study communities. An influx of cash into a small, rural community can have both positive and negative impacts on sociocultural systems.

<u>Economy</u>

Historically, very few North Slope residents participate in direct oil and gas activities in the North Slope; however, North Slope residents that live near existing oil developments have participated in oil and gas jobs such as ice road monitors, camp security and facilities operators, and subsistence representatives. Training programs geared towards developing special skills required in oilfield services are expected to create more employment opportunities for residents of Kaktovik, given their proximity to the region where oil and gas activities are likely to occur. Petroleum development in the region is expected to generate revenues to the NSB government, the State, and the federal government from royalties,

income taxes, production taxes, and property taxes. Local businesses including the Kaktovik Iñupiat Corporation (KIC), could potentially benefit from petroleum development.

Public Health and Safety

All action alternatives are likely to be below applicable air quality standards for all project phases, however, people who are particularly vulnerable to respiratory problems may experience health problems at locations or during episodes with poorer air quality. Water contamination could occur through accidental discharge, however, the likelihood of any such discharge occurring with the resultant human exposure is low, given the stipulations and best management practices around waste prevention, handling, disposal, spills, and public safety. If exposure were to occur, it would be likely short-term and intermittent, and unlikely to lead to significant health effects. There is a low likelihood of contamination of subsistence food sources, with the possible exception of contamination through an oil spill. Kaktovik residents remain concerned that oil and gas activities could increase contaminant loads of subsistence foods to a level that would threaten human health. Any oil and gas development is likely to reduce confidence in subsistence food sources and possibly reduce consumption of subsistence sources. Noise level increases from construction or operation of oil and gas facilities could result in potential effects ranging from minor irritation and annoyance to more severe health outcomes. Given the likely location of development away from Kaktovik, individuals at cabins or camps near developments would be most impacted. Until site-specific development activities are proposed, the extent of this effect is not possible to determine. Increased income for Kaktovik residents and families has the potential to improve health through increases in the standard of living, reductions in stress, and opportunities for personal growth and social relationships, however, with other oil and gas development within the NSB, income and employment have been found to be associated with an increased prevalence of social pathologies, including substance abuse, assault, domestic violence, and unintentional and intentional injuries. Oil and gas development in the program area has the potential to increase the risk of injuries and accidents during subsistence activities and increasing use of roadways has the potential for increasing risk of motor vehicle accidents and injuries.

Recreation

Under all action alternatives, there would be an increased level of recreation use in the program area. This would be the case particularly on lands that are easily accessed from nearby communities or waterways. With this increased use, the social recreational setting would continue changing resulting in more frequent and intense user interactions. Over time, more rules and regulations to control access and use may be needed. These changes would cumulatively impact the quantity and quality of recreation opportunities that can be offered and the recreation experience and benefit opportunities that can be provided. Of relevance to environmental justice concerns, these increases in recreational use also have the potential to further adversely impact existing subsistence uses of the area.

Alternative B

Subsistence Uses and Resources

Alternative B would result in the greatest potential impact to caribou calf survival and overall herd numbers due to the amount of lands available for oil and gas leasing. Alternative B would include 0.5-1 mi setbacks (with no permanent oil and gas infrastructure, including roads and pipelines, allowed) for 8 major rivers, many of which (e.g., Hulahula, Okpilak, and Jago rivers) are key drainages used for

subsistence activities. Some timing restrictions on human activity would be in place for calving and post-calving habitats of the PCH which could reduce impacts to resource abundance and availability.

Sociocultural Systems

Because of its proximity to the program area, the community of Kaktovik would experience the greatest intensity of both impacts and benefits associated with the proposed oil and gas leasing program. Impacts on sociocultural systems may also occur for other communities if oil and gas development in the program area results in changes to resource abundance and/or availability, particularly caribou which is a resource of major importance to the closest communities of Kaktovik, Nuiqsut, Arctic Village, and Venetie. Because of the particular spiritual and cultural importance of the coastal plain and PCH calving grounds to the people of Arctic Village and Venetie, any disruption to that herd or perceived contamination or degradation of calving grounds within the program area would have sociocultural impacts on the Gwich'in in terms of their belief systems, cultural identity, and the impact of development within the sacred calving grounds of the PCH.

Economy

Economic effects would be similar to those discussed above. There could be unquantifiable differences in economic effects due to the required operating procedures associated with the various stipulations under Alternative B. Some of these actions could also result in delays in exploration, development, and production activities and would therefore also delay potential employment and income effects as well as revenues that could accrue to the local, state, and federal governments.

Public Health

Perceived and actual threats to subsistence activities and harvest patterns are a primary source of ongoing concern and stress in North Slope communities. Avoidance of productive land may reduce harvests and exacerbate dietary and nutritional outcomes independent of any direct impact on the animals themselves. Any reductions in the success of subsistence harvests for Kaktovik residents would potentially cause a shift from subsistence resources to store-bought foods, worsening nutritional outcomes and food insecurity.

Alternative C

Subsistence Uses and Resources

Under Alternative C, stipulations would provide additional protections for caribou calving grounds and pads and CPFs would not be allowed within 1 mile of the coast, although essential pipelines and roads may still occur. In addition, Alternative C would impose greater timing restrictions on human activity within the PCH post calving habitat area than Alternative B. Demographics impacts to the PCH would be less likely than Alternative B, therefore, the intensity of subsistence impacts under Alternative C would be less than Alternative B.

Sociocultural Systems

Of the noted additional stipulations, the intensity of sociocultural impacts related to caribou under Alternative C would be less than Alternative B.

Economics

The economic effects under Alternative C would be similar in magnitude to the economic effects discussed above. Similar to Alternative B, there could be differences in economic effects resulting from the alternative-specific stipulations, but these effects would be difficult to quantify.

Public Health

Through additional protection for caribou, Alternative C would likely decrease the potential for impacts on Kaktovik residents' subsistence harvest, and the likelihood and severity of health impacts from reduced subsistence harvests, increased reliance on store-bought food, and food insecurity.

Alternative D

Subsistence Uses and Resources

Under Alternative D, lease sales on calving grounds would be most limited of all action alternatives and more lands would be subject to development and timing restrictions. Therefore, Alternative D would be the least likely to impact calf survival and overall herd numbers of all action alternatives. Alternative D also includes larger setbacks from key subsistence drainages than other action alternatives, including 4 mi of the Hulahula and 3 mi of the Okpilak river, which would greatly reduce impacts to subsistence in those areas, particularly during the winter months. Under Alternative D, no pads or CPFs would be allowed within two miles of the coast, reducing potential impacts to coastal subsistence hunters and fishers. In addition, reclamation of infrastructure would be on ongoing process for each development area, thus lessening the duration of impacts for individual developments related to infrastructure. Alternative D would require greater design features meant to address impacts to subsistence resources and users, and greater consultation with tribal governments on design features, timing, development methods, and access.

Sociocultural Systems

Because of increased caribou calving grounds avoidance, and because more lands would be subject to development restrictions, the intensity of sociocultural impacts under Alternative D would be less than under Alternative B.

Economy

Given the higher level of restrictions under Alternative D, the difference in the level of economic effects under this alternative would be higher compared to the differences in economic effects under Alternatives B and C. These increased restrictions could reduce the amount of oil produced and defer or reduce revenues and taxes.

Public Health

Similar to Alternative C, through additional protection for caribou, Alternative D would decrease the potential for impacts on Kaktovik residents' subsistence harvest, and therefore the likelihood and severity of health impacts from reduced subsistence harvests, increased reliance on store-bought food, and food insecurity.

Cumulative Impacts

Sustained contact with outside entities and institutions, including decades of oil exploration and development conducted by the federal government and industry, have directly impacted habitat use and

behavior of subsistence species and resulted in additive impacts on subsistence resources, harvest patterns, and users. These effects have altered livelihoods and ways of life and account for some of the social disruptions seen in villages today. Oil and gas development has also provided the underpinning of a regional economy that has enabled the NSB a greater degree of local control and self-determination in addressing socioeconomic and sociocultural issues, although dependence on an undiversified economy based on the extraction of natural resources has created other challenges. The leasing program would likely contribute to cumulative impacts in a variety of ways across the subsistence, sociocultural, economic, and public health spectrum.

As noted in BLM (2018) climate change can be understood as an environmental justice issue. The Iñupiaq of the North Slope are disproportionately impacted by it both by the fact that climate change effects are more pronounced in the western Arctic and by the fact that Iñupiaq subsistence activities are particularly dependent on ice, wind, and permafrost conditions. Climate change is perceived as causing changes to the environment of the North Slope and as affecting subsistence users' ability to access subsistence resources at appropriate times (Brinkman et al. 2016). The reduction of sea ice has exacerbated coastal erosion, the weather has become less predictable, the shore ice in spring is less stable for whaling, fall travel for caribou is hampered by a late and unreliable freeze up, spring hunting for geese is hampered by an early breakup, ice cellars provide less reliable food storage. All of these issues create significant concerns for many Iñupiat because they are perceived as factors that cannot be controlled and that are threatening their way of life. Similar concerns also apply to those who are not on the North Slope but nevertheless dependent on subsistence resources of the North Slope, including Gwich'in communities of Arctic Village and Venetie.

Subsistence Uses and Resources

Cumulative impacts to subsistence in addition to impacts from climate change could alter subsistence use areas, user access, and resource availability for Iñupiaq and Gwich'in subsistence users. Over time, changes in how residents access and use the land, and reduced opportunities for participation in subsistence harvesting, processing, distribution, and celebrations resulting from decreased harvests, could have negative effects to culture by weakening social ties and knowledge of cultural traditions.

Sociocultural Systems

Increased interactions with outsiders in traditional use areas and communities has the potential to affect traditional values and belief systems over time and may also result in increased social problems if such interactions lead to greater access to drugs and alcohol. Cumulatively, strong local economies could have positive social impacts as long as communities are able to adapt to such changes while maintaining cultural traditions and values. Communities that are most likely to experience negative sociocultural impacts would be those that experience impacts on subsistence while not benefitting from increased income or employment (e.g., Arctic Village and Venetie).

Economy

The oil and gas leasing program and subsequent exploration, development, and production activities in the program area will increase oil production on the North Slope and increase TAPS throughput. Economic activity would increase at the local, regional, and state level due to direct industry spending on labor, materials, and services. Government revenues would increase from shared royalties, tax payments such as property taxes, corporate income taxes, severance taxes, and other local taxes. Job opportunities for Alaskans would increase, including residents of communities in the NSB, and increased

labor income would increase in regions where industry spending would occur and where the oil and gas workforce resides.

Public Health

For the majority of past, present, and reasonably foreseeable future projects, the village of Kaktovik and its residents have been buffered by being surrounded by undeveloped lands. Air and water quality in and around the village remains relatively untouched, subsistence harvests have not been noticeably affected, and the influx of oil-and-gas revenue for the North Slope Borough has improved infrastructure within the village. High rates of accidents and injury are primarily due to subsistence activities and food security for Kaktovik households remains a concern. Future development offshore in the Beaufort Sea could could increase the risk of accident and injury by changing the subsistence harvest patterns and requiring more time on the water to harvest animals. The onshore leasing alternatives would have similar contributions to the cumulative effects on public health for Kaktovik residents with the pathways described above. Current levels of contamination of traditional food and water supplies in the region are low and, in the absence of major spills or accidents, are unlikely to significantly change under any alternative. However, perception of contamination is already high. Oil-and-gas development, particularly in areas of traditional use and subsistence harvest as would be the case under could increase the perception of contamination and may result in changes in consumption patterns. Disruptions to subsistence harvest patterns and conflicts between uses of the land can lead to an increased risk of injury in hunters. All action alternatives would increase the likelihood of injury due to industrial use of land previously used only for subsistence activity. Continuing economic development and increasing revenues to the local governments under all action alternatives would support maintenance of Kaktovik infrastructure and systems. The direct and indirect employment resulting from oil and gas exploration and development combined with the government and Native corporation revenues are all major contributors to the positive health changes in the North Slope Borough over the last few decades. The activities under all action alternatives would contribute to these ongoing benefits, with greater levels of employment generally being more likely to be associated with good health.

3.4.6 Recreation

Affected Environment

Recreation opportunities and settings in the program area are largely as described in the Arctic Refuge CCP (USFWS 2015), which is incorporated here by reference; a summary is provided below.

The primary recreation opportunities in the program area are wildlife viewing, camping, backpacking, hiking, photographing, hunting, fishing, and boating (Christensen et al 2009). These activities include hunting and fishing for federally qualified subsistence users, permitted commercial activities, such as guided float trips and hunting, and individual visitors engaged in dispersed recreation, such as backpacking and photographing. Polar bear viewing and ski touring are also popular (USFWS 2018).

The recreation setting of the program area is remote; in many cases, visitors do not encounter other people during their visit. Most people visit the program area in the summer and fall when near constant daylight provides unique multiday recreation opportunities. Weather, surface water and land surface conditions, and near continual darkness limit or prevent access to many parts of the program area during the winter and spring.

There is limited overland motorized access to or in the program area. Motorized recreation opportunities and use of motor vehicles to access other forms of recreation consist mainly of snowmachines, which are legal during periods of adequate snow cover. Most snowmachine use is associated with subsistence activities. The only roads are near the community of Kaktovik. Access to inland areas is either by boat, such as along the Kongakut, Canning, or Hulahula Rivers, by aircraft, or by foot. Most visitors to the inland portions of the program area arrive by chartered aircraft, which is part of their special use permit. They are permitted to land on water or where surface conditions permit it. Individual hikers and backpackers enter the program area from the north via Kaktovik, or to a lesser extent, from the south via the Dalton Highway through the Arctic Refuge Wilderness Area.

More than 90 percent of visitor access the program area is via airplane, with more than 80 percent of all visitors arriving via chartered planes (Christensen et al. 2009). Other visitors access recreation opportunities in the decision area via boat or on foot. During the summer and fall, the Kongakut, Canning, and Hulahula Rivers support most water-based access to the interior areas. Visitors typically travel by plane to the rivers' headwaters in the southern portion of the program area and float northward toward the Arctic Ocean. Most recreation is in these river corridors. In 2017, river floating accounted for approximately 60 percent of all reported guided recreation activities in the program area (BLM 2018). Backpackers, base campers, and hunters, which account for the remaining 40 percent of reported commercial visits, are also likely to use river corridors during all or a portion of their visit.

As described in the Arctic Refuge CCP (USFWS 2015), the Kongakut River is popular among visitors during late spring and early summer to observe the caribou migration and in August to hunt. Caribou are the primary game species hunted in the program area, which is entirely within GMU 26C. There is subsistence hunting of caribou and marine mammals that takes place in the program area (see **Section 3.4.3**, Subsistence Uses and Resources). In 2017, approximately 8 percent of all reported guided recreation in the program area was hunting (BLM 2018).

In 2017, four commercial air service operators provided air taxi service for 1,400 visitors; another seven chartered polar bear viewing excursions for 1,600 visitors. Air taxi service supported recreation for 850 river floaters, 300 backpackers, 40 base campers, and 100 hunters (BLM 2018).

Polar bear viewing is an increasingly popular activity in the program area. In 2013, it represented approximately one quarter of all recreation visits; in 2016 and 2017, it accounted for more than half (BLM 2018). There are viewing opportunities near Kaktovik, including through guided viewing tours. Expanded infrastructure at Kaktovik supports international visitors seeking the unique opportunity of viewing polar bears outside of captivity.

Direct and Indirect Impacts

Impacts on recreation in the program area would result from management that enhances or diminishes the quality of the recreation setting, limits access or physically displaces visitors or subsistence users because of new surface disturbance or development, increases or decreases conflicts between recreational uses (e.g., in high use areas), increases or decreases the ability of commercial operators to carry out specially permitted activities, or enhances or diminishes subsistence opportunities.

Alternative A

Under Alternative A, no oil and gas leasing program would take place within the program area; there would be no direct or indirect impacts to recreation within the program area. Existing impacts on recreation would continue to occur. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

The magnitude, spatial extent, and duration of impacts on recreation would vary based on season, type of recreation activity, and location in the program area. In general, the potential for impacts on recreation would be greatest during the summer and fall months when weather and daylight conditions allow for the greatest number and type of recreation uses. Similarly, the potential for impacts would be greatest along river corridors, the Beaufort Sea coastline, and other areas where the number of recreation users is highest. Because visitors to the program area generally expect a physical setting consisting of little to no human disturbance and a social setting with little to no interaction with other visitors or human activity, small changes to the physical and social setting can have disproportionally large impacts on user experiences.

Protective measures intended to limit ground disturbance and associated impacts on resources would improve recreation by limiting or prohibiting surface disturbing activities that could diminish the quality of recreation experiences, conflict with recreation opportunities, or displace visitors and subsistence users. The magnitude of impacts on recreation would be directly related to the type and extent of proposed stipulations or required operating procedures under each alternative. In general, maintaining or improving resource conditions increases the quality of recreational experiences (Dorwart et al. 2009).

The program area offers recreationists unique primitive recreation experiences that depend largely on the physical setting. Visual quality contributes to the physical setting and directly influences recreationists' satisfaction with recreation opportunities in the program area. Undisturbed landscapes contribute to higher-quality recreation opportunities. Protective measures attached to leases, such as NSO stipulations, that prevent surface disturbance and the placement of aboveground infrastructure would eliminate the potential for changes to visual quality and associated physical setting. Where aboveground development is allowed, stipulations that minimize the visual contrast of new development, such as by requiring design elements that compliment the predominant natural features of the characteristic landscape, would reduce the intensity of visual impacts and associated change to the recreation setting.

Night sky conditions are a component of visual quality that also contribute to the recreation setting and user experiences. The addition of artificial lighting at facilities and from vehicles would diminish the quality of night sky conditions, especially in the winter and spring months when daylight hours are shortest. Diminished night sky conditions during the winter and spring would affect fewer visitors compared with daytime visual impacts, this is because there are fewer visitors to the program area during that time of year. However, any new artificial light would result in an intense impact on those visitor experiences because there are very few artificial light sources currently in the program area. Similarly, artificial lighting during the limited nighttime hours in the summer and fall would result in a

short duration, but intense impact, which could diminish the overall quality of visitor experiences. There would also be an indirect impact on visitor experience where artificial light reduces visitors' ability to observe the Northern Lights. Protective measures that prevent the placement of aboveground infrastructure or specify the use of downcast lighting or other light trespass mitigation measures would minimize impacts on the quality of nighttime recreation experiences.

The magnitude of impacts on the recreation setting from visual quality, including night skies, would decrease relative to users' increasing distance from the source of any visual impact or artificial light. However, the relatively flat topographic characteristics of the program area would result in new mineral development infrastructure being visible from far distances. Also, because there is no development currently, any new development that would be visible to recreation users would modify the recreation setting and visitor experiences. Even with protective measures to minimize visual impacts, surface disturbance and infrastructure development would modify the existing character of the landscape, diminish visual quality, and directly affect the quality of the recreation setting and associated experiences. The intensity and duration of the impact would depend on the type and location of the development relative to recreation opportunities.

Noise from mineral development following a lease sale would modify the recreation setting and could diminish visitor experiences. The magnitude of impacts depends on distance between the observer and the noise source, duration and frequency of the noise, time at which the noise occurs, presence of topographical features or vegetation that attenuates noise, stipulations or mitigation strategies that reduce noise levels. The use of compression technology would increase the noise levels associated with mineral production. More frequent aircraft and ground-based vehicle trips could also increase the occurrence of noise impacts from those sources. Noise impacts on recreation would diminish further from the source because noise attenuates with distance.

Restricting surface-disturbing activities in leased areas to protect wild and scenic rivers would maintain the quality of recreation opportunities and prevent the displacement of users along the river corridors. Stipulations that apply wider surface-disturbance buffers from wild and scenic rivers would maintain user experiences in the river corridors more than stipulations with narrower buffers. This is because narrow buffers would allow development closer to the river corridor, resulting in greater potential for that development to diminish the recreation setting. Impacts would be greatest where disturbance and development occurs along river corridors, such as the Hulahula and Jago Rivers, with the highest number of users.

Lease sales resulting in mineral exploration and production and associated pipelines, private roads, mineral material sites, and other infrastructure can physically displace recreation opportunities and prevent access to areas for recreational use. The magnitude and type of impacts would depend on the location of the development and recreation activity impacted. Not offering areas for lease sale or making areas available subject to NSO would eliminate the potential for these impacts by precluding the placement of new surface infrastructure that could displace visitors and limit access for visitors and subsistence users. Applying CSU stipulations can limit the types or extent of facilities, which could reduce the intensity of impacts on recreation; however, aboveground infrastructure in CSU areas would still have the potential to prevent access and displace visitors. The potential for impacts would be greatest during the summer and fall when visitation is highest and near river corridors and other areas

where visitors concentrate. However, permanent infrastructure would displace all types of visitors, year-round, and over the long term.

Overland heavy equipment vehicle use for seismic work could physically displace winter users when the equipment is in use. Vehicle operation would also produce noise and artificial light, which could detract from the primitive recreation experience. Over snow heavy vehicles used for seismic work can leave grid lines on the landscape visible by aircraft following snow melt. This is the result of compacted snow melting slower than surrounding areas creating darker vegetation patterns matching the gridlines used for the seismic work. This modification could influence the experiences of visitors arriving by air.

Recreationists in the program area rely heavily on commercial operators for access to desired recreation opportunities and experiences. Changes in resource conditions, including physical resources such as visual quality, and biological conditions, such as wildlife, would directly influence the quality of recreational experiences obtained through commercial operators. For example, mineral development in leased areas that relocates or decreases polar bear or caribou populations would diminish the ability of operators to provide clients with desired recreation experiences. This could lessen the viability of certain operations resulting in fewer permitted operators, which would indirectly impact recreation by reducing access to the program area via specially-permitted means.

Alternative B

Under Alternative B, making available 1,563,500 acres for lease sales, of which 85 percent (1,326,100 acres) would be available for surface use would result in direct and indirect impacts on recreation throughout nearly the entire program area. The nature and types of effects on recreation described above would result from lease sales that would be followed by the construction and operation of an anticipated 19 drill pads and construction of CPFs, gravel roads, pipelines, STP, and gravel pits to support mineral development. Over time as exploration, well pad development, road construction, and extraction occur, there would be a steady decline in the recreation setting from changes to the visual quality and night sky compared with Alternative A. Noise from construction, production, aircraft, and vehicles would also diminish the quality of the recreation setting. With the intensification of development through the construction and production phases, there would be a steady increase in surface disturbance, which would increase the potential for visitor displacement and restrictions on access for visitors and subsistence users. New roads would create up to 1,600 acres of dispersed, linear barriers. Year-round vehicle traffic on the roads would contribute to noise, visual, and light-related impacts on the primitive recreation uses that occur in the program area.

One-mile setbacks from the Canning, Hulahula, and Jago Rivers, and narrow setbacks for other rivers that serve as primary recreation use areas, would directly impact the recreation setting and visitor experiences as described above. The narrow setback would provide little opportunity for vegetation or topography to provide consistent screening of new facilities or vehicle traffic from view of users in the river corridors. Drill pads, roads, and pipelines near these river corridors would also physically displace visitors from areas outside the setbacks. Concentrating recreation uses in narrow river corridors would increase the density of activity in those corridors compared with Alternative A, which would increase the number of interactions among visitors. This would directly affect the social setting and could increase the potential for conflicts among different types of recreation users.

There would be no specific protection measures to minimize disturbance in polar bear denning critical habitat, which could result in species displacement, or decline. Over time, fewer viewing opportunities would lessen the viability of commercial operators providing guided polar bear viewing experiences. This could reduce the number of specially-permitted operators and indirectly limit future opportunities for visitors to experience polar bears outside of captivity.

Minimal protection measures for development in caribou summer, calving, and post-calving habitat areas could lead to displacement and possible decline in caribou populations, which would decrease hunting and viewing opportunities. Impacts on caribou populations would also indirectly affect the viability of commercial recreation uses that provide guided hunting and viewing opportunities. Fewer operators would result in an overall decline in opportunities to access the program area for recreational use.

Not requiring final abandonment to meet minimal standards for Wilderness eligibility and allowing exceptions to abandonment conditions could allow for the long-term, permanent degradation of the program area's primitive recreation setting.

Alternative C

Compared with the No Action Alternative, new oil and gas development following lease sales on up to 1,086,900 acres would diminish the quality of the recreation setting and visitor experiences, displace visitors and subsistence users, and increase conflicts between users. Following the lease sales, the nature and types of impacts described above would result from the construction and operation of an anticipated 19 drill pads and construction of CPFs, gravel roads, pipelines, STP, and gravel pits to support mineral development. The intensity and distribution of impacts would be similar to those described under Alternative B; however, additional stipulations and a larger NSO area would result in slightly fewer impacts than Alternative B.

Four-mile NSO setbacks from rivers, such as the Canning and Hulahula Rivers, would maintain recreation opportunities and avoid the displacement of visitors in those popular recreation corridors. The potential for user conflicts in river corridors would be the same as Alternative A, this is because the wide corridor setbacks would support visitor dispersion in the corridor without being constrained by development.

Where unobstructed by topography or vegetation, infrastructure and vehicle traffic would be visible from the rivers. This would alter the recreation setting and could contribute to diminished user experiences. Where vegetation and topography provide screening, impacts would be nearly the same as Alternative A. The exception would be at nighttime when artificial lighting skyward of any new facilities would be visible, which would impact recreation as described in the nature and types of effects discussion, above. A narrower 1-mi setback along the Jago River would result in impacts the same as Alternative B. Outside the river corridor setbacks, the potential for displacement of visitors and limitations on access would be the same as Alternative B and as described in the nature and types of effects discussion, above.

Protection measures limiting activity in polar bear denning habitat and caribou summer, calving, and post-calving habitat would minimize the potential for species dispersion, or decline, which would indirectly maintain the quality of hunting and wildlife viewing experiences. This would also maintain the viability of specially-permitted commercial operators.

In the long-term, requiring final abandonment to meet the USFWS minimal standards for Wilderness eligibility would provide for the program area's return to a primitive recreation setting. The removal of facilities and restoration of disturbed areas would eliminate displacement and access impacts associated with those features.

Alternative D

Impacts on recreation under Alternative D would be similar to those described under Alternative C. The exception would be that making 1,037,200 acres available for leasing, of which 708,600 acres (45 percent) would be NSO, would largely concentrate the nature and types of impacts described above into a smaller portion of the program area. Compared with Alternative A, the greatest potential for impacts would be in the 340,500 acres (21 percent of the program area) available for leasing with surface use. However, some impacts associated with an anticipated 20 well pads and associated infrastructure would occur inside of the NSO areas. These would include changes to the nighttime recreation setting from artificial light trespass and alteration of the recreation setting and visitor experiences from the visual presence of infrastructure and vehicles.

Cumulative Impacts

Cumulative impacts on recreation would be the result of actions or circumstances, both within or outside the ability of BLM to manage, that would enhance or diminish the quality of the recreation setting, limit access or displace visitors or subsistence users, increase or decrease conflicts between recreational uses, increase or decrease the ability of commercial operators to carry out specially permitted activities, or enhance or diminish subsistence opportunities. Past, present, and reasonably foreseeable future actions described in **Appendix M**, that would cumulatively impact recreation include increasing recreation use in the planning area, energy and infrastructure development, and climate variability.

Under all alternatives, there would be an increased level of recreation use in the program area. This would be the case particularly on lands that are easily accessed from nearby communities or waterways. With this increased use, the social recreational setting would continue changing resulting in more frequent and intense user interactions. Over time, more rules and regulations to control access and use may be needed. These changes would cumulatively impact the quantity and quality of recreation opportunities that can be offered and the recreation experience and benefit opportunities that can be provided.

The unique character of landscapes in the program area will continue to change in response to climate change (BLM 2018). Increasing temperatures would directly impact recreation by reducing the length of the winter season and associated opportunities to participate in over snow activities. This could increase the potential for user conflicts as more visitors frequent the area for winter sports during a shorter time frame. Warmer temperatures associated with climate change would also increase the potential for direct and indirect impacts on recreation from the earlier melting of permafrost and variable stream flows, which are alter or diminishing the quality of recreational experiences and the ability of visitors to access them.

Under all action alternatives, oil and gas development, would increase the presence of well pads, pipelines, roads, and other infrastructure, which would displace recreation in the program area. Combined with increased visitation and other reasonably foreseeable future actions, new infrastructure

development would diminish the quality of the recreation setting and associated recreation experience. Visitors displaced from certain areas because of oil and gas activity could choose alternate locations in the program area to recreate, which could lead to more frequent conflicts among recreation users in those areas.

3.4.7 Special Designations

Affected Environment

Arctic National Wildlife Refuge Purposes

The Arctic National Wildlife Range was established in 1960 by Public Land Order 2214 "For the purpose of preserving unique wildlife, wilderness and recreational values.…" In 1980, ANILCA redesignated the range as part of the larger Arctic Refuge. It also designated much of the original range as wilderness under the 1964 Wilderness Act and provided four purposes that guide management of the entire refuge. Section 20001 of the 2017 Tax Act amended Section 303(2)(B) of ANILCA to add a fifth purpose related to the oil and gas program on the Coastal Plain. **Table 3.4.7-1** identifies the section of this EIS where impacts of oil and gas leasing on Arctic Refuge purposes can be found.

Table 3.4.7-1
Arctic National Wildlife Refuge Purposes

Purpose	EIS Section Describing Impacts on Refuge Purpose
(i) to conserve fish and wildlife populations and habitats in their natural diversity	3.2.2 Air Quality 3.2.8 Soil Resources 3.2.10 Water Resources 3.3.1 Vegetation and Wetlands 3.3.3 Fish and Aquatic Species 3.3.4 Birds 3.3.5 Terrestrial Mammals 3.3.6 Marine Mammals
(ii) to fulfill the international fish and wildlife treaty obligations of the United States	3.3.5 Terrestrial Mammals
(iii) to provide the opportunity for continued subsistence uses by local residents	3.4.3 Subsistence Uses and Resources
(iv) to ensure water quality and necessary water quantity within the refuge	3.2.10 Water Resources
(v) to provide for an oil and gas program on the Coastal Plain	3.2.5 Geology and Minerals 3.2.7 Petroleum Resources 3.4.11 Economy

Marine Protected Areas

The USFWS (2015, Section 4.1.3.3, Marine Protected Area) described marine protected areas (MPAs). The discussion below tiers to and incorporates by reference relevant information, while placing emphasis on the program area.

MPAs come in a variety of forms and are established to protect ecosystems, preserve cultural resources, such as shipwrecks and archaeological sites, or sustain fisheries production. MPAs are defined as "…any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein" (Executive Order 13158, Marine Protected Areas, May 26, 2000).

The DOI nominated the Arctic Refuge in 2005 and it was accepted for inclusion in the national system of MPAs. There are no special conditions for managing the Arctic Refuge MPA, but designation provides its managers with an opportunity to study and better understand the ecological quality and function of its coastal areas.

All marine waters within the Arctic Refuge boundaries and marine waters and lagoons off the northern coast of the program area (1,652,100 acres; BLM GIS 2018) are listed as part of the National MPA System.[30] Shifting shorelines and marine-freshwater boundaries at river mouths create some variability in the acreage estimate for the refuge's contribution to the National MPA System, on the order of plus or minus several hundred acres (USFWS 2015).

Wild and Scenic Rivers

The USFWS (2015, Appendix I Wild and Scenic River Review) described Wild and Scenic Rivers (WSRs). The discussion below tiers to and incorporates by reference relevant information, while placing emphasis on the program area location.

WSRs are rivers or segments of rivers designated by Congress under the authority of the Wild and Scenic Rivers Act of 1968 (Public Law 90-542, as amended; 16 USC 1271–1287). The purposes of the law are preserving the river or river section in its free-flowing condition, preserving water quality, and protecting its outstandingly remarkable values (ORVs). They are identified on a segment-specific basis and may include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values.

The Wild and Scenic Rivers Act mandates protections for rivers that are designated rivers of the National Wild and Scenic River System (NWSRS) and for those that are recommended for inclusion in the NWSRS. A river's preliminary classification (either wild, scenic, or recreational; based on level of development), free flowing condition; water quality; and ORVs must be maintained. The Marsh Fork-Canning and Hulahula Rivers were found to be eligible and suitable for inclusion in the NWSRS (USFWS 2015). The recommendation for including the Marsh Fork-Canning and Hulahula Rivers in the NWSRS was carried forward to Congress in 2015.

The sizes and the ORVs and preliminary classification of each eligible and suitable river in the program area are presented in **Table 3.4.7-2**, below.

Table 3.4.7-2
Eligible and Suitable Rivers Within the Program Area

River	Preliminary Determination	Miles USFWS-Administered Land	Preliminary Classification	Outstandingly Remarkable Values
Canning	Eligible	41	Wild	Cultural, wildlife, fish, recreational
Hulahula	Eligible and Suitable	26	Wild	Recreational and cultural
Jago	Eligible	36	Wild	Wildlife
Okpilak	Eligible	33	Wild	Scenic and geologic

Sources: FWS GIS 2015

[30] See the viewer of the NOAA National MPAs here: https://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/mpaviewer/.

Wilderness Characteristics, Qualities, and Values

The USFWS (2015, Appendix H Wilderness Review) described the wilderness characteristics in the Arctic Refuge. This section tiers to and incorporates by reference relevant information, while placing emphasis on the program area location. There have been no new data on the wilderness values associated with the program area since the completion of the 2015 Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015).

The 1964 Wilderness Act established a national system of lands to preserve a representative sample of ecosystems in a natural condition for the benefit of future generations. Public Land Order 2214 (1960) established the original Arctic Range and identified three purposes of preservation: wilderness values, wildlife, and recreational values. ANILCA Section 101(b) outlines the intent "to preserve in their natural state extensive unaltered arctic tundra...ecosystems; and to preserve wilderness resource values and related recreational opportunities including but not limited to hiking, canoeing, fishing, and sport hunting, within large arctic and subarctic wildlands and on free-flowing rivers…." Further, ANILCA 304(g)(2)(B) requires the Secretary of the Interior to identify and describe "the special values of the refuge, as well as...wilderness value of the refuge" when developing plans.

The Wilderness Act describes four primary qualities of wilderness:

- Apparent naturalness
- Outstanding opportunities for solitude or primitive and unconfined recreation
- At least 5,000 acres of land or a sufficient size to make practicable its preservation and use in an unimpaired condition
- Ecological, geological, or other features of scientific, educational, scenic, or historical value

These qualities are found throughout the program area, except for certain tracts in the vicinity of Kaktovik.

In the Arctic Refuge CCP (2015) the USFWS recommended the lands in the program area for wilderness designation. Areas recommended for wilderness would continue to be managed under the minimal management category as they are now (USFWS 2015, Section 2.3.3).

Direct and Indirect Impacts

Marine Protected Areas

The Arctic Refuge MPA was accepted for inclusion in the national system of MPAs in 2005. MPAs have legally established goals, conservation objectives, and intended purpose such as to conserve biodiversity in support of research and education; to protect benthic habitat in order to recover over-fished stocks; and to protect and interpret shipwrecks for maritime education. These descriptors of an MPA are reflected in the site's conservation focus, which represents the characteristics of the area that the MPA was established to conserve. The indicator used to assess the degree of effects on the Arctic Refuge MPA is the primary conservation focus for this area, natural heritage, which are zones established and managed wholly or in part to sustain, conserve, restore, and understand the protected area's natural biodiversity, populations, communities, habitats, and ecosystems; the ecological and physical processes upon which they depend; and, the ecological services, human uses and values they provide to this and future generations (NOAA 2017).

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the program area would be offered for future oil and gas lease sales. Current management actions for the MPA would be maintained and resource trends would continue, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

Under all action alternatives, the natural heritage conservation focus of the MPA could be affected by activities or development which cause a loss of sea ice, changes in freshwater input, increased rates of coastal erosion or accretion, increased shipping activity, offshore development, oil spills, or an introduction of invasive species associated with marine shipping.

Alternative B

Under Alternative B, oil and gas leasing would be emphasized within the Coastal Plain. Impacts from exploration and development activities could affect the MPAs natural biodiversity (see **Section 3.3.3**, Fish and Aquatic Species, and **Section 3.3.6,** Marine Mammals). Marine and coastal ecosystem impacts would likely occur in the northwestern portion of the program area as exploration wells would be focused in this high potential zone for oil and gas development. Barge landings and staging areas used to transport materials and supplies for facilities could have indirect long-term impacts on the MPA by increasing rates of coastal erosion. A more site-specific analysis would occur during the Advanced Planning Document (APD) phase of development.

The Lease Stipulation 9 (Coastal Areas) would require lessees, operators, and contractors to conduct a coastline survey in the coastal area between the northern boundary of the ANWR and the mainland, and inland areas within 2-miles of the coast. The lessees, operators, and contractors would then be required to develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on these coastal area habitats and their use by wildlife and people. This analysis would help reduce long-term impacts to the Refuge MPA natural heritage conservation focus that activities under this alternative could present.

Alternative B presents the highest number of acres available for oil and gas leasing (1,563,500 acres) and the fewest restrictions for disturbances to marine and coastal environments. Impacts to the ANWR MPA would be greatest under Alternative B compared to the action alternatives as there would likely be more transportation of materials and supplies for oil and gas development in the coastal areas. A more site-specific analysis would occur during the APD phase of development.

Alternative C

Under Alternative C, oil and gas leasing would be balanced with biological and ecological concerns throughout the program area. Impacts would be similar to those as described under Alternative B, but more constraints would apply, thereby reducing the intensity of impacts to the Arctic Refuge MPA.

Similar to Alternative B, the lessees, operators, and contractors would be required to develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the

effects of the infrastructure and its use on these coastal area habitats and their use by wildlife and people. Under Alternative C, the Lease Stipulation 9 (Coastal Areas) would also require an NSO standard which would not allow exploratory well drill pads, production well drill pads, or central processing facilities for oil and gas development within coastal waters, lagoons or barrier islands within the boundaries of the coastal plain area or 1 mile inland of the coast.

Alternative C presents the second highest number of acres available for oil and gas leasing (1,086,900 acres). Impacts to the ANWR MPA would be more than under Alternative A due to the increase in transportation of materials and supplies for oil and gas development in the coastal areas than is likely to occur under current management. A more site-specific analysis would occur during the APD phase of development.

<u>Alternative D</u>

Under Alternative D, portions of the coastal plain (526,300 acres) would not be offered for lease sale out of concern for biological and ecological resources. Impacts would be similar to those as described under Alternative B, but more constraints would apply, thereby reducing the intensity of impacts to the Arctic Refuge MPA.

Similar to Alternative C, the Lease Stipulation 9 (Coastal Areas) would require an NSO standard for exploratory well drill pads, production well drill pads, or central processing facilities within coastal waters, lagoons or barrier islands within the boundaries of the coastal plain area. Under Alternative D, Lease Stipulation 9 would also require an NSO standard 2 miles inland of the coast for these same development features.

Under Alternative D, the Lease Stipulation 9 would require a timing limitation which would not allow oil and gas exploration operations on the major coastal waterbodies and coastal islands between May 15 until the later of November 1 or sea ice is within 10 miles of the coast of each season, whichever is later. This stipulation would also require that vessels used as part of a BLM-authorized activity would maintain various buffer distances from specific wildlife species (see **Section 3.3.6,** Marine Mammals) which would reduce impacts to the natural heritage conservation focus of the Arctic Refuge MPA by reducing impacts to the biodiversity of the coastal area.

Alternative D presents the fewest number of acres available for oil and gas leasing (1,037,200 acres) of the action alternatives. Impacts to the Arctic Refuge MPA would be more than under Alternative A due to the increase in transportation of materials and supplies for oil and gas development in the coastal areas than is likely to occur under current management. A more site-specific analysis would occur during the APD phase of development.

<u>Cumulative Impacts</u>

Past actions and events contributing to cumulative effects within and near the Arctic Refuge MPA have resulted primarily from surface-disturbing activities such as oil and gas exploration, development, production, and transportation for these uses including shipping routes for delivery of development materials. Oil and gas development near the program area is expected to continue, which would also increase associated transportation activities such as shipping and barging materials and supplies to the program area. As a result, activities affecting the indicators for MPAs would also continue. The potential for cumulative impacts would be highest under Alternative B, which would include the most areas being

available for oil and gas leasing and have the fewest stipulations to protect the Arctic Refuge MPA conservation focus.

Wild and Scenic Rivers

The following indicators were used to assess the degree of effects on WSR quality: any potential change to the ORVs, tentative classification, or free-flowing nature of the river segment or corridor area from its current state (see **Appendix M**, Approach to the Environmental Analysis). Impacts on recreational uses are described under **Section 3.4.6**, Recreation.

<u>Alternative A</u>

Under Alternative A (No Action Alternative), no federal minerals in the program area would be offered for future oil and gas lease sales. Current management actions for WSRs would be maintained and resource trends would continue, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015). The USFWS would manage the four eligible rivers to maintain their preliminary classifications of wild.

<u>Impacts Common to All Action Alternatives</u>

Under all alternatives, the BLM would comply with the Wild and Scenic Rivers Act by maintaining water quality in by ensuring that authorized uses comply with state water quality standards. Management actions that prohibit surface-disturbing activities, including NSO, CSU, and TL stipulations near the eligible and suitable WSRs, would provide varying protections for ORVs. This would also ensure that the tentative WSR classification of each river remains intact. General impacts resulting from oil and gas development in the program area could include soil erosion and habitat fragmentation, which could impact cultural, fish, geologic, recreation, and wildlife ORVs. The degree of impacts on WSRs would be dependent on the proximity of development to the WSR. Site-specific level analysis would occur during the APD phase of development.

<u>Alternative B</u>

Under Alternative B, Lease Stipulation 1 (Rivers and Streams) would require an NSO standard which would prohibit permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, in the streambed and within the described setback distances outlined in **Table 3.4.7-3**.

Table 3.4.7-3
Eligible and Suitable River Setback Distances Under Alternative B

River	Preliminary Classification	Setback Distance
Canning	Eligible	From the western boundary of the Coastal Plain to 1 mile east of the eastern edge of the active flood plain
Hulahula	Eligible and Suitable	1 mile in all directions from the active flood plain
Jago	Eligible	1 mile from the banks' ordinary high-water mark
Okpilak	Eligible	1 mile from the banks' ordinary high-water mark

Source: USFWS 2015

For streams located entirely within the Coastal Plain (**Map 3-44**, **Special Designations** in **Appendix A**), the setback extends to the head of the stream as identified in the National Hydrography Dataset[31]. On a case-by case basis, essential pipeline and road crossings to the main channel will be permitted through setback areas. The setbacks may not be practical within river deltas. In these situations, permanent facilities would be designed to withstand a 200-year flood event.

Overall, because this alternative offers the highest number acres available for oil and gas leasing adjacent to WSRs (41,900 acres) and the fewest restrictions for disturbances to WSRs, Alternative B would have the greatest magnitude of impacts to WSRs of all the alternatives. The majority of the acres available for oil gas leasing (40,900 acres) would be managed as NSO, but 1,000 acres would only be subject to standard terms and conditions. Of the 1,000 acres subject to standard terms and conditions, 800 acres would be within areas of high hydrocarbon potential.

Alternative C

Under Alternative C, the requirements of the Lease Stipulation 1 (Rivers and Streams) are the same as those described under Alternative B with the same setback distances for oil and gas development. However, under Alternative C, there are 16,200 fewer acres of eligible and suitable WSR corridors in areas available for oil and gas leasing (primarily in the southern portion of the program area) than under Alternative B, which reduces the potential for impacts to their preliminary classification and ORVs.

Alternative D

Under Alternative D, impacts from requiring the Lease Stipulation 1 (Rivers and Streams) would be similar as those described under Alternative B, but the setback distances would be larger for most of the eligible and suitable rivers outlined in **Table 3.4.7-4**. Alternative D would have 19,500 fewer acres of eligible and suitable WSR corridors in areas available for oil and gas leasing than under Alternative B, which reduces the potential for impacts to their preliminary classification and ORVs.

Table 3.4.7-4
Eligible and Suitable River Setback Distances under Alternative D

River	Preliminary Classification	Setback Distance
Canning	Eligible	From the western boundary of the Coastal Plain to 3 mi east of the eastern edge of the active flood plain
Hulahula	Eligible and Suitable	4 mi in all directions from the active flood plain
Jago	Eligible	1 mi from the banks' ordinary high-water mark
Okpilak	Eligible	3 mi from the banks' ordinary high water mark

Source: USFWS 2015

Alternative D would provide further protections to the fish and recreational ORVs of the Canning and Hulahula rivers by implementing Required Operating Procedures such as preparing gravel mine site design and reclamation plan which excludes this activity in areas that support populations of freshwater, anadromous, or endemic fish.

[31] National Hydrography Dataset: https://nhd.usgs.gov/

Cumulative Impacts

Past actions and events contributing to cumulative effects within or next to rivers have resulted primarily from surface-disturbing activities such as oil and gas exploration, development, production, and transportation for these uses. Activities of oil and gas development near the program area is expected to continue. As a result, surface-disturbing activities such as oil and gas development, transportation, and recreation affecting rivers would continue. However, the BLM and USFWS would maintain discretionary authority over most land uses and would permit only those actions that would not impair or conflict with river systems, reducing cumulative effects on these areas. As development and transportation increases, access and use within or next to rivers would also increase. Reasonably foreseeable future actions that may affect WSRs would be similar to past and present actions. Cumulative impacts may be reduced or avoided if future actions or decisions in the program area incorporate measures to reduce or avoid impacts on river-related values. Examples are ORVs, tentative classification, or the free-flowing nature of eligible or suitable segments in the program area, in accordance with the Wild and Scenic Rivers Act.

Wilderness Characteristics, Qualities, and Values

In general, discussions of impacts to wilderness characteristics, qualities, and values tend to be more qualitative in nature, measured by the overall visual quality and naturalness of an area that may be affected by changes to levels of recreational activities, development, and surrounding land use. Indicators of wilderness characteristics include changes to the untrammeled and naturalness of the program area, opportunities for solitude or primitive and unconfined recreation, or to other unique or supplemental values.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the coastal plain would be offered for future oil and gas lease sales. Current management actions for wilderness characteristics would be maintained and resource trends would continue, as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015). Current USFWS management focuses on less manipulation of the environment and promoting actions that facilitate solitude, self-discovery, self-reliance, remoteness, and primitive or unconfined recreational experiences that would have negligible, indirect, long-term, and positive effects on wilderness characteristics.

Impacts Common to All Action Alternatives

Management actions associated with oil and gas leasing that could impact the natural appearance of lands in the program area could include the presence or absence of roads and trails, use of motorized vehicles on those roads and trails, seismic data acquisition using vibroseis trucks, construction of facilities and infrastructure for energy development, or other actions that result in or prevent surface-disturbing activities. All of these activities affect the presence or absence of human activity and, therefore, could affect an area's natural appearance and opportunities for solitude in the program area.

Alternative B

Alternative B has the most acres available for oil and gas leasing (1,563,500) and the fewest restrictions on surface disturbance activities. Impacts on wilderness characteristics under Alternative B from oil and gas development would be reduced in the areas being managed as NSO (264,100 acres) or areas with TLs (844,400 acres). Prohibiting surface-disturbing activities and new developments in certain locations

through the NSO and TL stipulations would maintain the program area's apparent naturalness, and opportunities for solitude or primitive and unconfined recreation. Any new roads authorized for access to the program area could diminish or eliminate wilderness characteristics. Temporary and permanent access routes to a lease area or mine site traveled by developers would negatively impact the wilderness character of that area. The degree of impacts on wilderness character would be dependent on the intensity of development, which would be further analyzed during the site-specific APD phase of development.

Alternative C

Under Alternative C, there would be no impacts on wilderness characteristics from oil and gas development in the areas that are not offered for lease sale (476,600 acres), and impacts would be reduced in the areas being managed as NSO (389,800 acres) or areas with TLs (350,700 acres). Detrimental impacts to wilderness character would be similar as those described under Alternative B, but to a lesser degree due to more areas not offered for a lease sale and being managed with NSO and TL requirements.

Overall, Alternative C would allow 1,086,900 acres to be available for oil and gas lease sales in the program area, which would impact wilderness characteristics more than Alternative A.

Alternative D

Under Alternative D, there would be no impacts on wilderness characteristics from oil and gas development in the areas that are not offered for lease sale (526,300 acres), and impacts would be reduced in the areas being managed as NSO (708,600 acres) or areas with TLs (204,700 acres) stipulations. Detrimental impacts to wilderness characteristics would be similar as those described under Alternative B, but to a lesser degree due to more areas not offered for a lease sale and being managed with NSO and TL requirements.

Alternative D would also implement the Lease Stipulation 10 (Wilderness Boundary), which would further protect apparent naturalness and opportunities for solitude from visual obstructions and noise in the program area and the adjacent Mollie Beattie Wilderness Area by prohibiting surface occupancy and planning to minimize aircraft operations flights below 2,000 feet within 3 miles of the southern and eastern boundaries of the Coastal Plain where they are adjacent to the Mollie Beattie Wilderness Area.

Cumulative Impacts

Past actions and events contributing to cumulative effects within nearby Wilderness Areas or lands with wilderness characteristics have resulted primarily from surface-disturbing activities such as oil and gas exploration, development, production, and transportation on existing routes for these uses. Activities of oil and gas development near the program area is expected to continue. As a result, surface-disturbing activities affecting the indicators for wilderness characteristics would also continue. The potential for cumulative impacts would be highest under Alternative B, which would include the most areas being available for oil and gas leasing and have the fewest stipulations to protect wilderness characteristics from surface disturbing activities.

3.4.8 Visual Resources

Affected Environment

Visual resources are the visible physical features on a landscape, such as land, water, vegetation, animals, structures, and other features. The BLM completed a visual resource inventory (VRI) for the Central Yukon Planning Area (BLM 2018) to the west of the Coastal Plain, using the process in the BLM's Visual Resource Inventory Handbook (H-8410-1). The VRI was based on physiographic divisions. Although the program area is not in the BLM's Central Yukon Planning Area VRI, the VRI is used to characterize its visual resources because physiographic divisions span both areas.

It is reasonable to characterize the program area using the Central Yukon Planning Area VRI because there are negligible differences between the two areas. The three physiographic divisions that span both areas are the Arctic Coastal Plain, Arctic Foothills, and Ambler-Chandalar Ridge and Lowland (**Map 3-45, Physiographic Divisions** in **Appendix A**). Physiographic divisions can span large geographic areas, regardless of landownership; the transitions between physiographic divisions are generally subtle.

Scenic quality is a measure of the visual appeal of a tract of land. All public lands have scenic value, but areas with the most variety and harmonious composition have the greatest value (BLM 2018). In the VRI, each physiographic division was evaluated to determine its scenic quality. The Arctic Foothills and the Ambler-Chandalar Ridge and Lowland divisions received the highest scenic quality rating and have a great deal of visual variety, contrast, and harmony. The Arctic Coastal Plain received the second highest scenic quality rating and has a moderate amount of visual variety, contrast, and harmony. These three physiographic divisions are described below.

This Arctic Coastal Plain physiographic division occurs in most of the program area and covers 1,369,900 acres, 90 percent of the program area (BLM GIS 2013). It is characterized by a smooth poorly drained plain rising imperceptibly from the Arctic Ocean, with scattered groups of low hills on the east and a much flatter section on the west. An abrupt scarp between 50 and 200 feet high separates the Arctic Coastal Plain from the Arctic Foothills to the south. Pingos are sufficiently abundant to give an undulatory skyline.

All the rivers in this unit feed into the Arctic Ocean, crossing the program area in braided channels and deltas creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars and delta areas. Water is a major element of this landscape. This physiographic division has a low variation in topographic relief and a low variety of plant species found in the vegetation types of wet and moist tundra; low shrubs create some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow and alder.

This Arctic Foothills physiographic division is in the southern part of the program area and covers 127,600 acres, 8 percent of the program area (BLM GIS 2013). It is characterized by rolling plateaus and low linear mountains. It has broad east-trending ridges, dominated locally by mesa-like mountains in the north, while the southern area displays irregular buttes, knobs, mesas, and east-trending ridges rising 2,500 feet above the surrounding intervening, gently undulating tundra plains. Major rivers are swift, braided courses across broad gravel flats. There are a few small thaw lakes in the river valleys with morainal lakes closer to the program area.

The Arctic Foothills are crossed by north-flowing braided rivers from sources in the Sadlerochit and Romanzof Mountains creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars. The entire area is underlain by permafrost, with ice wedges, stone stripes, polygonal ground, and other frost features creating contrast with different vegetation types and barren ground. This physiographic division has a moderate variation in topographic relief. It has a low variety of alpine and moist tundra species, such as low mat-like herbs, grasses, and heaths. High to medium shrub thickets create some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow.

This Ambler-Chandalar Ridge and Lowland physiographic division occurs in the southeast corner of the program area and covers 28,000 acres, 2 percent of the program area (BLM GIS 2013). It is characterized by east-trending lowlands with elevations of 600 feet and low passes 3 to 10 miles wide, with elevations of 4,000 feet. Rolling to rugged ridges 25 to 75 miles long and 5 to 10 miles wide rise to 4,500 feet and are characteristic of the northern portion of this unit (Romanzof Mountains). Major rivers are tributaries of the Okerokovik and Angun Rivers. Large rock-basin lakes occur in the valleys, while floodplains of major streams have thaw and oxbow lakes. The entire area is underlain by permafrost.

All the rivers in this physiographic division feed into the Arctic Ocean, crossing the program area in braided channels and deltas, creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars and delta areas. This physiographic division has a moderate variation in topographic relief and has a large variety of alpine tundra of low mat-like herbs, grasses, and heaths. It also features closed white spruce and birch forests, with high to medium shrubs, and open low-growing black spruce and willow shrubs. These create some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow.

Vegetation is an important component in determining the visual quality of an area, represented by species, variety, extent, and color. The more variety of species a landscape has, the higher the scenic quality. Vegetation visible in the program area is alpine tundra, closed spruce forests, moist tundra, open and low-growing spruce, shrub thicket, treeless bogs, and wet tundra.

Cultural modifications are also considered in determining the visual quality of an area. Cultural modifications can blend in with or stand out from the surrounding landscape. The program area is still primarily a natural landscape, where humans have not substantially changed the scenic quality; however, some areas have been modified by the activities of humans. Buildings are the most likely to be seen and have most modify the natural landscape. Buildings primarily exist near the community of Kaktovik.

Native allotments and isolated cabins can also be found in the program area. Most of the buildings outside a community are in relative harmony with the landscape, as they are small and made of local materials and have primarily natural colors. Other modifications are airports and airstrips. While an airport is more developed and has tall structures associated with the site, the profile of an airstrip is low, with landform changes that are introduced by brown colors in predominantly green vegetation and more regular lines than the surrounding irregular vegetation.

Artificial light sources are mainly limited to the community of Kaktovik along the coast. Dispersed cabins, overland travel, recreation, and occasional single- and twin-engine aircraft overflights can also create limited, intermittent points of artificial light.

Summer travel is primarily by watercraft; however, snowmachine trails and winter travel routes can be seen from elevated locations. Summer all-terrain vehicle travel is low to nonexistent and does not have visible trails.

Seismic exploration, authorized by Congress, was conducted in the program area during the winters of 1984 and 1985. Exploration during winter causes less damage to tundra vegetation and soils than in summer, but damage does occur. Because of the 1984-1985 seismic exploration, known as 2-D (two-dimensional) seismic, 1,250 miles of trails made by drill, vibrator, and recording vehicles crisscrossed the Coastal Plain tundra. Additional trails were created by D-7 Caterpillar tractors that pulled ski-mounted trailer-trains between work camps. The trails were about 4 miles apart. While 90 percent of all trails recovered well during the first 10 years after exploration, 5 percent of trails had still not recovered by 2009, 25 years after the disturbance. This indicates that about 125 miles of disturbed trail remained in 2009, based on a total length of about 2,500 miles of original trails, both seismic lines and camp-move trails (USFWS 2014). These trails disrupt the visual continuity of the expansive, undeveloped landscape. They can be discerned from the air but do not dominate when viewed from the ground or rivers.

Areas identified as having public concern for the scenic quality are known travel routes (especially rivers), areas of human habitation, areas of traditional use, and areas near Native allotments. Numerous areas are noted to have potentially high visual sensitivity. This is because area residents and visitors view the natural landscape as very important and have a high level of interest and sensitivity to changes to the natural landscape. Visual resources in the program area are viewed by various users of the refuge. Views can be affected by weather conditions and time of day or year.

Users include the following:

- Individuals participating in cultural activities (see **Section 3.4.2**, Cultural Resources)
- Individuals conducting subsistence activities (see **Section 3.4.3**, Subsistence Uses and Resources)
- Individuals in the village of Kaktovik (see **Section 3.4.4**, Sociocultural Systems)
- Recreationists (see **Section 3.4.6**, Recreation, **Section 3.4.7** Special Designations)
- Individuals en route to various destinations (see **Section 3.4.9**, Transportation)

Direct and Indirect Impacts

This section addresses impacts on visual resources from actions associated with each alternative. The program area is the geographic scope of the analysis area for direct and indirect impacts. Impacts are quantified where possible. In the absence of quantitative data, best professional judgment is used to provide a qualitative description of impacts. Although the BLM administers the oil and gas leases, a BLM visual resource management system visual resource inventory was not conducted, but would be conducted in subsequent NEPA analyses for oil and gas actions, such as the APD phase.

In the event of an oil spill, visual resources would be affected by the spill itself, cleanup activities, and any residual changes to the landscape. See **Section 3.2.11**, Solid and Hazardous Waste for more discussion on oil spills.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals would be offered for future oil and gas lease sales. Current management actions would be maintained, and resource trends would continue. There would be no new impacts on visual resources. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

There would be no impacts on visual resources common to all action alternatives, because actions would occur in different areas according to lease stipulations in **Chapter 2** (**Maps 2-2, Alternative B, Individual Stipulations; 2-4, Alternative C, Individual Stipulations; 2-6 Alternative D1, Individual Stipulations; 2-8 Alternative D2, Individual Stipulations for the action alternatives** in **Appendix A**).

Alternative B

Impacts on visual resources would occur from oil and gas actions, such as exploration, development and operation. **Appendix E**, RFD Scenario, identifies oil and gas actions that would likely occur.

Surface disturbance would impact visual resources. Although the 2,000 acres of surface disturbance that could occur represents 0.13 percent of the program area, it would not be clustered in a specific area, but rather spread out. There would be various discrete facilities connected by a network of gravel or ice roads and pipelines.

In addition to the 2,000 acres of surface disturbance, there would be additional surface disturbance at gravel pits that would impact visual resources. Under Alternative B, gravel needs for road and pads would be approximately 12,509,000 cubic yards. Assuming a 50-foot pit depth, the gravel pits to supply gravel needs would be approximately 155 acres. At a 25-foot pit depth, approximately 310 acres would be required. The number and locations of gravel pits is unknown.

The pipelines are supported by vertical support members. Only the vertical support members (and not the pipelines) are included in the 2,000 acres of surface disturbance. As a result, the 60 miles of pipelines connecting the satellite pads to a CPF would add to the disturbance that would impact visual resources. Under Alternative B, there could be three CPFs, one in the western portion of the high HCP area, one in the eastern portion of the high HCP area, and one in the moderate HCP area south of Kaktovik (this CPF could potentially be on Native lands). In total, there could be 180 miles of pipelines associated with this alternative.

The impacts on visual resources from the 2,000 acres of surface disturbance, 12,509,000 cubic yards of mined gravel, and 180 miles of pipelines would impact visual resources. During construction, crews may be working concurrently at various locations. Views of the program area would be cluttered with construction equipment, construction materials, and temporary support infrastructure. The bold colors and geometric, boxy forms of artificial construction vehicles, materials, and equipment would not resemble the colors and forms of the surrounding terrain and vegetation. The contrast would be starker during the winter when the surrounding landscape is white this snow. Rigid vertical elements would create various focal points on an open landscape and would not resemble other landscape elements,

which is mostly short vegetation during the summer. These impacts would only occur when construction equipment, construction materials, and temporary support infrastructure are present.

Construction and operations would generate dust from vehicle movement, excavation, and wind blowing across exposed gravel or soil. Fugitive dust would diminish atmospheric clarity. This impact on visual resources would persist until the dust settles or is blown elsewhere. Dust that settles on snow or ice would change the color of the surface from a light or white color to the color of the dust. This impact on visual resources would persist until the snow or ice melts and the dust is washed away.

Construction would use vehicle lights and other lights to illuminate work sites for visibility and safety. Also, reflective surfaces on construction equipment and vehicles would create glare. During operations, lights would also be used to illuminate sites for visibility and safety. Also, reflective surfaces structures would create glare. The intensity and amount of light and glare would vary depending on the intensity and angle of sunlight and the time of day and year. This would add artificial points of illumination that is nearly absent in the program area. The impacts from construction lights would only occur when construction equipment and vehicles are present. The impacts from operations lights would be long-term. The most noticeable operations lights would be at the pads, airstrip, barge landing, and on taller structures (such as the drill rigs). They would be more visible during nighttime and winter when there are fewer daylight hours. Artificial light would, in turn, affect the presence and behavior of animals viewed in the program area. Given the negligible artificial light in the program area, operations lights would essentially be the only sources of light that would diminish the quality of dark skies.

After construction, the ground surface would be disturbed by covering it with gravel, such as for roads and pads. The flat and simple gravel base would not resemble the uneven and complex forms of the undisturbed areas immediately beyond the surface disturbance. It would also introduce linear and angular forms to a surface devoid of discernable forms. The gravel would create a sharp edge that boldly divides disturbed areas from undisturbed areas. The gravel roads would also introduce contrasting bands that divide the expansive landscape. These would be more prominent in areas where roads do not follow the slope of the terrain. Because of a lack of vegetation on the gravel base, the darker smooth gravel base would not resemble the rougher vegetation with muted greens and tans beyond the gravel. These changes would, in turn, affect the presence and behavior of animals viewed in the program area. These impacts would be long-term.

Similar to gravel roads, pipelines would impact visual resources. Pipelines would introduce linear and rounded forms to a landscape devoid of discernable forms. The pipelines would also introduce contrasting bands that divide the expansive landscape. These would be more prominent in areas where roads do not follow the slope of the terrain. The pipelines would stand out against the surrounding muted greens and tans. Depending on orientation, the texture of the pipelines would be smooth or bumpy compared with the rougher vegetation. These changes would, in turn, affect the presence and behavior of animals viewed in the program area. These impacts would be long-term.

The gravel pads would be developed with drills and facilities. The bold and rigid forms of the drills and facilities would contrast with the indistinct and soft forms of the surrounding undisturbed surface. The angular lines of the drills and facilities would create various focal points on an open landscape and would not resemble other landscape elements, which is mostly short vegetation during the summer. The vertical lines of the drills and facilities would be more visible during daytime and summer, when there are more daylight hours and opportunities for silhouetting to occur. The multiple colors of the drills and

facilities would stand out against the muted greens and tans beyond the gravel pads. The contrast would be starker during the winter when the surrounding landscape is white this snow. The dispersed drills and facilities would create a stippled texture across a landscape with no vertical elements. These changes would, in turn, affect the presence and behavior of animals viewed in the program area. These impacts would be long-term.

An example of what gravel roads, pads, drills, and facilities could look like are depicted in **Figures 3-6** and **3-7**. The above impacts disrupt the visual continuity of the expansive, undeveloped, and open landscape by establishing dispersed, artificial structures and a network of roads and pipelines, none of which are found elsewhere in the program area. The locations of impacts on visual resources are shown in **Map 2-1, Alternative B** for Alternative B in **Appendix A**. Setbacks would minimize impacts on visual resources associated with, for example, wild and scenic rivers. The impacts on visual resources from Alternative B would not occur under Alternative A.

The publication *Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands* (BLM 2013) presents BMPs to avoid or reduce visual impacts associated with the siting, design, construction, operation, and decommissioning of utility-scale renewable energy generation facilities, including wind, solar, and geothermal facilities. Although the publication is for renewable energy generation facilities, the BMPs are also directly applicable to oil and gas facilities. Implementing the BMPs or using them as mitigation would reduce impacts on visual resources. Minimizing unnecessary disturbances through BMPs or mitigation is important to minimizing impacts on visual resources and, likely, other resources, because many impacts would persist until disturbed areas are reclaimed. Furthermore, arctic vegetation does not regenerate quickly, extending the timeline for reclaiming disturbed areas, as evidenced by the time it is taking disturbances to recover from seismic testing in 1984 and 1985.

Alternative C

The impacts on visual resources would be similar to Alternative B. However, Alternative C would use approximately 12,722,000 cubic yards of gravel (213,000 cubic yards more than Alternative B) and, therefore, would involve more surface disturbance that would affect visual resources. Alternative C would also occur in different locations, compared with Alternative B, and is shown in **Map 2-3, Alternative C** for Alternative C in **Appendix A**. The impacts on visual resources from Alternative C would not occur under Alternative A.

Alternative D

The impacts on visual resources would be similar to Alternative B. However, Alternative D would use approximately 12,420,000 cubic yards of gravel (89,000 cubic yards less than Alternative B). Also, Alternative D would have two CPFs, one in the central high potential area and one in the moderate potential area south of Katovik (this CPF could potentially be on Native lands). As a result, there would be 120 miles of pipelines (60 miles less than Alternative B). Therefore, there would be less disturbance that would affect visual resources. Alternative D would also occur in different locations, compared with Alternative B, and is shown in **Map 2-5, Alternative D1** and **Map 2-7, Alternative D2** for Alternative D in **Appendix A**. Setbacks, buffers, and surface occupancy prohibitions would minimize impacts on visual resources associated with, for example, wild and scenic rivers and wilderness areas. The impacts on visual resources from Alternative D would not occur under Alternative A.

Cumulative Impacts

The program area is the geographic scope of the analysis area for cumulative impacts. Impacts on visual resources in the program area from past actions occurred from the 1984-85 seismic exploration. About 125 miles of disturbed trail remained in 2009, based on a total length of about 2,500 miles of original trails (both seismic lines and camp-move trails) (USFWS 2014). The remaining trails create visible lines and faint variations in texture across the undeveloped landscape. Future seismic exploration would likely have more visible impacts on visual resources, because the trails would be several hundred feet apart, instead of three to four miles apart during the 1984-1985 testing. Past and future actions and the action alternatives would have cumulative impacts on visual resources. Given the durations of actions and the extent of construction and operation, the cumulative impacts on visual resources from the action alternatives would overshadow all other impacts on visual resources. Alternative A would have no cumulative impacts on visual resources.

Changes to the climate would affect visual resources. Vegetation and water sources are affected by the climate. Because visual resources include vegetation and water sources, changes to the presence and composition of vegetation and water sources would impact visual resources. Also, an increase in the active layer is expected from a warming climate, result in greater potential for areas of land subsidence. This would change landforms, as well as the vegetation and water sources that the land support. This would, in turn, affect the presence and behavior of animals viewed in the program area. Changes to the physical characteristics of the environment and biological resources (i.e. resources that are visible) are described in more detail in the Draft Supplemental Environmental Impact Statement for the Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project (BLM 2018).

3.4.9 Transportation

Affected Environment

The affected environment for transportation within the program area is as described in the Arctic Refuge CCP (USFWS 2015); a summary is provided below.

Except for in the village of Kaktovik, there are no designated roads in the program area; cross-country motorized travel, other than over snow, is prohibited. Year-round access to and in the program area is primarily via aircraft. There is a gravel landing strip at Kaktovik that supports air travel from outside the program area and serves as the departure point for aircraft traveling inland. Arctic Village and Venetie have gravel runways, which are owned by the Venetie Tribal Government. Aircraft are permitted to land in the program area; snow or water are the typical landing surfaces. Landing opportunities depend on topography, water levels, snow conditions, and weather. Kaktovik, Arctic Village, and Venetie all have regularly scheduled air service, although the frequency of service varies.

During the summer and fall, motorized and nonmotorized boats provide access along the program area's northern boundary with the Beaufort Sea. Primarily nonmotorized rafts are used on the Kongakut and Hulahula Rivers to access recreation and subsistence opportunities in the central portions of the program area. Subsistence users also use motorized boats where water levels and ice conditions permit. Improved boat technology, such as inflatable pack rafts that have shallow hulls, support river transportation in shallower areas that were previously unreachable by boat.

In the winter and spring, as snow cover conditions permit, overland travel via snowmachines is possible, especially along frozen waterways and the edge of the Beaufort Sea. Most snowmachine travel in the program area originates and terminates at Kaktovik. Snowmachine use in the program area is primarily for subsistence use, local travel, and some commercial recreation.

Affected Environment

The affected environment for transportation within the program area is as described in the Arctic CCP (USFWS 2015); a summary is provided below.

Except for within the village of Kaktovik, there are no designated roads in the program area and cross-country motorized travel, other than over-snow travel, is prohibited. Year-round access to and within the program area is primarily via aircraft. There is a gravel landing strip at Kaktovik that supports air travel from outside the program area and serves as the departure point for aircraft traveling inland. Arctic Village and Venetie have gravel runways, which are owned by the Venetie Tribal Government. Aircraft are permitted to land in the program area; snow or water are the typical landing surfaces. Landing opportunities depend on topography, water levels, snow conditions, and weather. Kaktovik, Arctic Village, and Venetie all have regularly scheduled air service, although the frequency of service varies.

During the summer and fall, motorized and nonmotorized boats provide access along the program area's northern boundary with the Beaufort Sea. Primarily nonmotorized rafts are used on the Kongakut and Hulahula Rivers to access recreation and subsistence opportunities in the central portions of the program area. Subsistence users also use motorized boats where water levels and ice conditions permit. Improved boat technology, such as inflatable packrafts that have shallow hulls, support river transportation in shallower areas that were previously unreachable by boat.

In the winter and spring, as snow cover conditions permit, overland travel via snowmachines is possible, especially along frozen waterways and the edge of the Beaufort Sea. Most snowmachine travel in the program area originates and terminates at Kaktovik. Snowmachine use in the program area is primarily for subsistence use, local travel, and some commercial recreation activities.

Direct and Indirect Impacts

Direct and indirect impacts on transportation would be from management that increases or decreases opportunities for new transportation infrastructure; management of the timing, location and type of vehicle use; and from changes in the level of public and subsistence use access in the program area. The magnitude, duration, and spatial extent of impacts on transportation would vary based on the location and extent of proposed transportation infrastructure, season and snow cover conditions, and other management, such as seasonal timing restrictions for certain uses, that would modify the nature of travel via certain modes.

Protective measures that specify the type and placement of new or expanded transportation infrastructure would affect the size, design, and location of the proposed infrastructure. For example, managing areas as NSO would preclude new transportation infrastructure. Stipulations that limit the placement of permanent transportation infrastructure depending on season and snow cover conditions, would seasonally reduce private transportation opportunities for oil and gas development, while minimizing potential conflicts with the public and subsistence users.

Management that limits vehicle use based on location, vehicle type, or season can limit or preclude access for certain travel modes while increasing access for others. For example, seasonal or location-specific limitations on vehicles used for mineral development would minimize the potential for impacts on other travel modes used for subsistence uses or recreation.

New transportation infrastructure, such as seasonal or year-round roads, if not available for public use, could create physical barriers for other forms of transportation and reduce access. If not available for public use, new roads, airstrips, and other infrastructure would not enhance public access opportunities.

Alternative A

Under Alternative A, no oil and gas leasing program would take place within the program area; there would be no direct or indirect impacts to transportation within the program area. Existing impacts on recreation would continue to occur. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

Under all action alternatives, lease sales would result in approximately the same number of subsequent gravel and ice roads, airstrips, fueling stations, and a barge landing area to support new oil and gas development. In areas subject to NSO stipulations, new roads, airstrips and other transportation-related infrastructure would be precluded. Under all alternatives, there would be no gravel roads constructed during the exploratory drilling phases; direct and indirect impacts described above associated with gravel roads would only occur in the long-term.

Under all alternatives, lease stipulations would limit the number of new roads to the amount necessary to support exploration and production activities. Protective measures would also require the free movement of caribou and subsistence users. These measures would maintain access for subsistence users. However, because transportation infrastructure would be closed to non-subsistence public users, there would be no increase in public access. In some areas, roads may obstruct cross country over snow travel via other modes, or nonmotorized travel, such as skiing or hiking. Compared with Alternative A, there would be no change in public access from the construction of private landing strips.

Alternative B

Under Alternative B, anticipated transportation infrastructure development and associated impacts following lease sales would be as described under Impacts Common to All Acton Alternatives. Up to 1,640 acres of new gravel roadways would support private travel for oil and gas production. Ice roads would provide additional private access for exploratory drilling and would be the primary means of overland access during the winter and spring for developers. Making available 1,563,500 acres for lease sales, of which 85 percent (1,326,100 acres) would be available for surface use, would allow for the construction of program-related roads throughout nearly the entire program area.

Alternative C

The nature and types of impacts under Alternative C would be nearly the same as those described above under Impacts Common to All Action Alternatives and under Alternative B. Not offering 476,600 acres for lease sale and applying an NSO stipulation to 25 percent (389,800 acres) of the area being

offered would limit the locations where new roads and other transportation infrastructure could be placed. This would also result in fewer areas where new transportation infrastructure associated with oil and gas development would conflict with public access.

Alternative D

Under Alternative D, not offering 526,300 acres for lease sale and applying an NSO stipulation to 68 percent (708,600 acres) of the area being offered would limit the locations where new roads and other transportation infrastructure could be placed. Compared with Alternative A, there would be no change in transportation conditions on approximately 1,251,900 acres (79 percent) of the program area that would either not be offered for lease sale or offered but managed as NSO. The nature and types of impacts described above would be in the 340,500 acres (32 percent of leased areas; 21 percent of the program area) available for leasing with surface use.

Cumulative Impacts

Cumulative impacts on transportation would be the result of past, present, and reasonably foreseeable future actions that would increase or decrease opportunities for new transportation infrastructure, change the types of vehicles available for use, or change the level of public and subsistence use access in the program area. Past, present, and reasonably foreseeable future actions described in **Appendix M**, Approach to the Environmental Analysis, that would cumulatively impact recreation include increasing visitation to the planning area for recreation and mineral exploration, energy and infrastructure development, and climate variability.

Under all alternatives, public visitation to the program area would increase for recreational use. With increased visitation, there would be more frequent conflicts among travel modes, which could result in localized declines in the level of access. This would be most likely to occur in the summer and fall when visitation is highest.

Under all action alternatives, oil and gas exploration and development, combined with increased visitation, would increase the potential for roads and other infrastructure to conflict with public access. These conflicts would be more likely along river corridors and the Beaufort Sea coastline where visitor concentrations are highest.

Increasing temperatures and associated loss of snow cover would limit the locations and times of year when ice roads would be viable. Less snow cover and soft tundra surface conditions could result in transportation infrastructure being concentrated in smaller areas. This could intensify traffic on those roads and increase the potential for conflicts with other modes as more visitors frequent the area.

3.4.10 Economy

Affected Environment

This section describes the existing socioeconomic conditions in areas that could be affected by exploration, development, and production in the Coastal Plain from the leasing program. All NSB communities, the NSB, and the state of Alaska are included for comparison purposes. Arctic Village and Venetie, which are communities outside the NSB, are also included in the discussion due to their reliance on subsistence resources in the program area.

This section provides baseline information on the following socioeconomic indicators: employment, income, population, and fiscal conditions (government revenues and expenditures). In addition, information on regional and village corporations and a description of local businesses, local facilities, and public infrastructure are presented.

The Coastal Plain, which is part of the Arctic Refuge, also has a non-use value associated with wilderness preservation. Because non-use values are not measurable through market data, this value is measured in terms of society's willingness to pay for wilderness preservation. This value is not quantified in this EIS. For a more detailed discussion of the definition of non-use values and valuation methods, see Valuing Option, Existence, and Bequest Demands for Wilderness (Walsh et al. 1984).

Population

Table L-1 in **Appendix L**, Economy, shows population estimates by the Alaska Department of Labor and Workforce Development (ADOLWD) by community/area from 2010 to 2017 (ADOWLD 2018a). At the NSB and state levels, population growth from 2010 to 2017 has been modest, at 4 percent. The communities of Atqasuk and Kaktovik have seen a slight decline in population, while all other communities in the NSB have experienced varying degrees of population growth. Arctic Village, Point Lay, and Nuiqsut have seen the most growth, each with more than 20 percent growth in population over this time frame.

Local Employment and Income

Table L-2 in **Appendix L**, Economy, provides employment and wage data by community (ADOLWD 2018b). The local government sector employs the highest number of workers in all communities. Private sector employment is highest in Utqiagvik, accounting for 43 percent of total resident employment, followed by Point Hope and Nuiqsut, where the private sector employs 39 and 38 percent of the resident workers. These communities also have the highest total wages in the region. Venetie has the highest rate of unemployment, with only 57 percent of residents employed. Artic Village and Venetie both show total community wages much lower than communities in the NSB. Employment and income at the borough and state levels are discussed in the regional economy and state economy sections, below.

Local Economy: Kaktovik

Kaktovik lies on the north shore of Barter Island on the Beaufort Sea coast, in the Arctic Refuge. It is the closest community to the program area. The following provides more details on the economy, infrastructure, and fiscal conditions of Kaktovik.

Kaktovik is the easternmost village in the NSB and is situated on approximately 1 square mile of land (630 acres) and water on the northeastern shore on the Kaktovik Lagoon. A detailed description of Kaktovik's history is provided in the Kaktovik Comprehensive Development Plan (NSB 2014). Residents in Kaktovik are predominantly Iñupiat (88 percent of the population). According to population estimates published by ADOLWD (2018a), 234 people lived in Kaktovik in 2017. The NSB's most recent census report indicated there were 262 residents in Kaktovik in 2015, while ADOLWD estimated 243 residents in that same year (NSB 2015).

Economic and employment opportunities are limited in Kaktovik because of its remoteness. Sixty-seven percent of the working residents are employed by the local government sector, and 33 percent work in

the private sector, primarily by Native corporations and their affiliates (ADOLWD 2018c). The Borough and NSB School District provide most of the local employment, and the Village Corporation and City government also provide some employment opportunities. Besides the local government sector, residents are also employed in construction, finance, leisure and hospitality, and other sectors (**Table L-3** in **Appendix L**, Economy). Short-term construction or skilled labor jobs with the oil industry, private construction firms, and the ASRC and its subsidiaries and summer jobs related to tourism can also be found. Subsistence hunting, fishing, and whaling play a major role in the local economy (NSB 2018).

There are 15 active businesses operating in Kaktovik, including the KIC, a hotel, a bed and breakfast, a store, and several tour and adventure businesses (ADCCED 2018a). The KIC runs the local store, which provides groceries, clothing, first-aid, hardware, camera film, and sporting goods. Fishing and hunting licenses, guide services, and aircraft and repair services for autos and aircrafts are locally available (NSB 2018).

The KIC is the Village Corporation established pursuant to ANCSA. KIC owns approximately 92,000 acres of surface lands in and around the community. All of the corporation's land is within the Arctic Refuge boundary. Kaktovik Holdings LLC is wholly owned by KIC and has three subsidiaries—Kaktovik Enterprises, LLC (which provides services on power generation, storage, and control), Kaktovik Environmental, LLC (which provides a variety of environmental engineering, consulting, and construction services), and Kaktovik Telecom, LLC (which provides full-service, turn-key solutions for all telecommunications and tower needs). The company's operations are in Alaska, the lower 48, and Guam (Kaktovik Holdings, LLC 2018).

The estimated per capita income in Kaktovik in 2016 was $21,925, which was lower than the $34,191 per capita income for the state (ADOLWD 2018d). The median family income was $66,250 compared to $87,365 for the state. The disparity between Alaska and Kaktovik income is important to note, given the high cost of living in Kaktovik.

The community incorporated as a second-class city in 1971.[32] For fiscal year (FY) 2018, the Kaktovik adopted a $1.46 million operating budget (ADCCED 2018a) (**Table L-4** in **Appendix L**, Economy). Seventy-six percent of the City's operating revenues are generated by local funds, such as taxes, services, and enterprise revenues, which account for 57 percent of the locally generated revenues. Outside sources, including the community revenue sharing from the State, NPRA funds,[33] and other grants contribute 24 percent to their operating budget.

The NSB provides public electricity, piped water, sewer services, and trash pickup to the community. Kaktovik has a public safety building and a fire station equipped with fire engines and an ambulance. The

[32] A type of general law municipality or city that has taxation powers but with certain limitations. Section 29.45.100 of the Alaska Statutes provides that limitations on the amount of property tax that may be collected apply only to taxes for operating expenses and not to taxes collected to pay for bonded indebtedness. A special limitation on taxation by second-class cities is that the city cannot levy property taxes exceeding 2 percent (20 mills) of the assessed value of property in the city in any one year (Alaska Taxable 2017, ADCCED, 2018).
[33] Allocated by the State of Alaska from the NPRA Impact Mitigation Grant Program. The program provides eligible municipalities with grants to help mitigate adverse impacts from oil and gas development in the NPRA. The fund is created from lease revenues, including sales, rentals, bonuses, and royalties.

Harold Kaveolook School offers education from pre-school through grade 12 and adult basic education. Communications include phones, internet, mail, public radio, and cable TV. The community also has a health clinic staffed by community health aides.

Transportation to the village is provided by scheduled airlines and air taxi service from Barrow and Fairbanks. Freight arrives by cargo plane and barge (during the summer). Air travel provides the only year-round access to Kaktovik. Marine transportation provides seasonal access to Kaktovik.

Regional Economy

The program area is in the NSB jurisdiction. Its population is predominantly Iñupiat. In 2017, the NSB was estimated to have a population of 7,248 living year-round in its eight communities. In addition to the permanent local population, a large number of oilfield workers lived in Prudhoe Bay in 2017 (2,601), contributing to the total regional population of 9,848.

Oil and gas exploration and development is the primary industry in the NSB and the largest employer of the region's industrial workforce, including nonresidents. In 2016, approximately 14,000 oil and gas jobs (including oilfield services companies) were reported in the NSB (McDowell Group 2017). These jobs are based in the North Slope, in self-contained work sites that are far from the NSB communities; however, few of the jobs are held by residents of the NSB. In 2016, 55 oil and gas jobs were held by NSB residents, which amounts to less than 0.5 percent of the total oil and gas jobs based in the North Slope. Total earnings from the oil and gas extraction sector, which amounted to about $864 million, accounted for 69 percent of the total wages earned for all industries in the North Slope in 2016 (ADOLWD 2018e); however, a large portion of the earnings are not spent in the local and regional economy, as most workers reside permanently outside the NSB.

The unemployment rate in the NSB in 2016 was 6.5 percent, which was roughly the same as the statewide unemployment rate of 6.6 percent (ADOLWD 2018f).

The local government sector (primarily the NSB government) is the largest employer of North Slope residents. In 2016, the local government sector employed 1,988 residents, accounting for 61 percent of the resident workers in the region.

The NSB government was formed in 1972. It provides a wide range of public services to all of its communities, including capital projects. Its total general fund revenue for the fiscal year 2017 to 2018 is approximately $376 million; 97 percent of the total general fund is sourced from property and sales taxes (ADCCED 2018b). Oil and gas property taxes are the primary source of revenue for the NSB government. In 2016, State-assessed oil and gas property in the NSB was valued at approximately $20.27 billion. The NSB received about $373 million in oil and gas property taxes (a tax levied on oil and gas infrastructure), accounting for 97 percent of the total property tax ($386 million) collected by the NSB that year (Office of the State Assessor 2017).

The ANCSA regional and village corporations in the North Slope are also important economic players in the region, employing residents, participating in the oil and gas service industry, and creating additional wealth in the region. ASRC is the regional ANCSA corporation that is owned by and represents the business interests of the North Slope Iñupiat. ASRC provides an array of oilfield engineering, operations, maintenance, construction, fabrication, regulatory and permitting, and other services for oil and gas companies.

Village ANCSA corporations in the NSB also are active in the oil and gas sector. For additional details on the North Slope ANCSA corporations, see Alpine Satellite Development Plan for the Greater Mooses Tooth 2 Development Project Draft SEIS, which is incorporated here by reference (BLM 2018).

State Economy

The petroleum industry is a major sector in the Alaska economy. Economic events related to the petroleum industry have pervasive effects across the state's economy. The drop in oil prices in late 2014 resulted in a significant decline in State government revenues. In early 2015 and in 2016, state government lost 1,200 jobs, while the oil and gas sector lost 2,900 jobs. Other sectors were also affected, for example the professional and business services sector lost 1,600 jobs and the construction sector lost 1,400 jobs (Wiebold 2018).

In 2016, the oil and gas extraction sector contributed 10 percent of the state's total gross domestic product ($50 billion), the highest among all industries in Alaska (Bureau of Economic Analysis 2018). This does not include the oil and gas support industries and the oil pipeline transportation sector.

In 2016, there were 11,100 direct oil and gas jobs in the state (Fried 2017). In addition to the direct jobs, there are thousands of indirect jobs in security, catering, accommodations, facilities management, transportation, engineering services, and logistics, which support the oil and gas industry, but are not categorized as oil and gas jobs. The most recent estimate for total direct and indirect jobs associated with the oil and gas industry in Alaska was 45,575 jobs in 2016; these jobs contributed $3.1 billion in total annual wages in Alaska (McDowell Group 2017).

The State government is highly dependent on oil revenue; its budget is sensitive to oil price and oil production. Petroleum-related revenues include oil and gas property tax, petroleum corporate income tax, oil and gas production taxes, mineral bonuses and rents, and oil and gas royalties (state and federal). The State's Unrestricted General Fund revenue is now forecast to be $2.3 billion in FY 2018 and $2.3 billion in FY 2019. The revenue forecast is based on an annual Alaska North Slope oil price of $61 per barrel for FY 2018 and $63 for FY 2019. The State expects oil prices to stabilize in the low $60s per barrel in real terms. The revenue forecast is also driven by an expectation for North Slope oil production to average 521,800 barrels per day in FY 2018 and increasing to an average of 526,600 barrels per day in FY 2019 (ADOR 2018).

In fiscal year 2017, the State of Alaska received $12.9 billion in revenues from all sources: petroleum[34] ($1.7 billion); non-petroleum[35] ($1.2 billion); investment ($6.8 billion); and federal revenues ($3.2 billion). The general fund unrestricted revenues (GFUR), the funds that are available for general state activities and capital projects, amounted to $1.35 billion, with petroleum revenues accounting for 65 percent of the unrestricted revenue. Petroleum royalties contributed $681 million to the GFUR, while petroleum property and oil and gas production taxes contributed $120 million and $134 million (ADOR 2018).

[34] Petroleum revenues include state taxes and royalties from oil production on both state and federal lands.
[35] Non-petroleum revenues include excise taxes, non-petroleum corporate income tax, fisheries tax, and other state taxes.

National Economy

Development in the Coastal Plain is anticipated to contribute to the nation's economy through job creation, increase in federal revenues, and increase in energy security (or reduced reliance on imported petroleum products). Comments from the public scoping for this EIS stated the importance of the economic benefits to the national economy and the concerns regarding the preservation of the region for its unique wildlife, wilderness, and recreation values.

Direct and Indirect Impacts

This section discusses the potential direct and indirect economic impacts of the various alternatives being considered in this EIS. The potential economic impacts are evaluated with respect to jobs, income, and government revenues at the local, regional, and statewide level. As noted in the Affected Environment section, quantifying non-market values associated with the Arctic Refuge is not part of this analysis. The temporal scope of the analysis covers potential impacts of leasing activities as well as the subsequent exploration, development, and production activities that could ensue following the leasing program through the year 2050.

Alternative A

Under Alternative A, no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales following the ROD for this EIS. The economic conditions at the local, regional, and state level as discussed in the affected environment section are therefore expected to continue. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

The potential economic effects of the mandated leasing program are evaluated based on the RFD Scenario which is described in detail in **Appendix E**. The baseline RFD is a set of development assumptions that reflect possible industry-wide exploration, development, and production activities. The scenario represents only a possible picture of the future. It is likely that different activities and timing will occur in the future, as each company that would participate in the leasing program would have their own unique plans about how to identify and recover the hydrocarbon resources. Furthermore, market conditions change over time and can impact outcomes. It is difficult to anticipate what the actual development pattern would be, but the assumptions used in this analysis provide a reasonable basis to evaluate potential future economic effects.

The Tax Act mandates that the first lease sale occur within the first 4 years of the implementation of the Tax Act and a second lease sale be held within 7 years. The RFD assumes that the first lease sale will occur within the first year of the ROD and that industry will aggressively lease and explore the tracts offered in the lease sales. Several industry groups will likely independently explore and develop new fields. The RFD scenario assumes that oil deposits of significant volumes will be discovered in the program area, resulting in the construction of up to 3 CPFs—one located in the western portion of the high HCP area, one located in the eastern portion of the high HCP area, and one in the moderate HCP area south of Kaktovik (this CPF could potentially be located on Native lands). Development in distant and remote areas like the program area would take time; this analysis assumes that first oil production from the first CPF will occur 10 years from the first lease sale.

The exploration phase of each anchor field and associated satellite fields can occur over a span of 10 years. Exploration activities include seismic surveys, well-site surveys, and drilling of exploration wells. Following discovery, the development phase normally takes 3 to 6 years. Development activities include obtaining permits, fabricating production modules, constructing roads, pipelines, and other on-site facilities, transporting materials and facilities to the site, and environmental studies and monitoring. The production phase can start after development of the central processing facility and would continue until the end of life of each oil field. Production activities include continued development-well drilling, production ramp-up, operations and maintenance of processing and other on-site facilities, well-workovers, infill drilling, and other support activities including environmental monitoring. For a more detailed discussion of the typical exploration, development, and production activities occurring in the Alaska North Slope, see *National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement*, which is incorporated here by reference (BLM 2012).

For the purposes of this analysis, the projections on potential economic impacts are only carried through the year 2050. Within this timeframe, it is assumed that only two anchor fields will be developed, with each one having its own CPF. A third CPF could be developed but will occur after the year 2050. Abandonment activities will also occur after this timeframe. The first anchor field is assumed to have about 400 million barrels of proven producible reserves. Six smaller satellite fields will be developed around this first anchor field with more modest producible reserves of about 100 million barrels each. The second anchor field is assumed to be discovered and developed several years after the first anchor field and will have four smaller satellite fields that will be developed by 2050 and tie into its CPF.

Indirect effects would include the spin-off effects of spending; these are also referred to as multiplier effects. They include additional economic effects that would result from in-state industry spending on goods and services, workers' spending of wages, and government spending of royalties and tax payments during the construction and operations phases. Like other development projects in the North Slope, it is expected that many of the materials and equipment would be purchased outside of Alaska and would be shipped to the job site. Still, a significant portion of the total project costs, both capital and operating costs, will be paid to companies in Alaska for construction, transportation, logistics, and other oilfield services[36]. It can be expected that some of the contracts for construction and operations and maintenance of the facilities would be awarded to Alaskan-owned and operated companies, including the North Slope regional and village corporations. These payments to local businesses will in turn generate additional economic activity within the state, resulting in indirect economic effects in the form of additional business sales, employment, and labor income. Likewise, local spending by workers as well as government spending of revenues would also generate multiplier effects statewide.

[36] The amount of direct in-state industry spending is based on purchase coefficients contained in the Alaska IMPLAN model. These in-state purchase coefficients reflect the availability of locally produced products within the state and are calculated from the trade model for the state within IMPLAN. The extraction of natural gas and crude petroleum sector, drilling oil and gas wells sector, and support activities for oil and gas operations sector require or demand different goods and services from other sectors of the economy and all have varying percentages of in-state purchases with the highest percentages in the services sector and the least in the manufacturing sectors. There is not one specific in-state purchase percentage applied to the total direct oil and gas industry spending, rather the purchase coefficients in the model vary by the type of goods and services purchased.

The following are some of the major assumptions and data sources used in the economic impact analysis:

- The RFD baseline scenario provided the basis for modeling the potential oil and gas activities and timeframes which included assumptions regarding the number of central processing facilities, gravel roads and ice road construction, other on-shore facilities including pipelines, and size of oil field discoveries.
- Estimates of production volumes by year were based on the size of each oil field and a production decline rate of 8 percent per year. This information was used to calculate potential royalty payments and other State and the Federal government tax payments.
- Oil price projections were obtained from the Energy Information Administration's 2018 Annual Energy Outlook (EIA 2018). This information was used to quantify potential royalty payments and other fiscal effects.
- Construction costs (CAPEX) were estimated based on costs provided in Attanasi and Freeman (2009) and cost data from other North Slope development projects. This information was used to calculate direct and indirect employment and income effects of construction spending as well as potential government revenues including oil and gas property taxes and state corporate income taxes.
- Estimates of annual operating expenditures are based on the prevailing operating costs in the Alaska North Slope- a fixed $/well/year estimate of $300,000 and a variable operating cost component of $10 per barrel of oil. These were default values in the ADNR cash flow model (ADNR 2018). This information was used to calculate the direct and indirect employment and income effects, as well as tax revenues during the production phase.
- Tariffs and transportation costs were used to calculate netback prices which are the bases for calculating royalty payments. Data on existing tariffs and transportation costs are from the ADNR Revenue Sources Book (ADNR 2018).

The IMPLAN model for Alaska was used to estimate the potential direct and indirect employment and income effects of the various exploration, development, and production activities. The cash flow model developed by the ADNR (modified to fit the development and production assumptions used in this analysis) was used to generate the projected royalties and government taxes.

<u>Jobs</u>

Exploration, development, and production activities in the program area for the two anchor fields and their associated satellite fields are estimated to generate about 250 direct jobs per year during exploration activities, 480 direct jobs per year during the development phase, and 730 direct jobs per year during the production phase. Exploration activities are anticipated to peak on the fifth year of the exploration phase, generating an estimated 650 jobs that year. The peak year of the development phase is estimated to generate 680 jobs, and 1,150 jobs are estimated to be required during the peak production year. Jobs during the exploration and development phases are seasonal and temporary while production phase jobs are year-round and would last through the economic limit of the life of each oil field. **Table 3.4.10-1** also provides estimates of the indirect jobs that could potentially be generated as a result of industry spending on exploration, development, and production activities.

Table 3.4.10-1
Projected Direct and Indirect Jobs: Exploration, Development, and Production Phases

Jobs (average number of part-time and full-time jobs)	Annual Average	Peak
Direct Effects		
Exploration	250	650
Development	480	680
Production	730	1,150
Indirect Effects		
Exploration	190	560
Development	3,180	4,570
Production	3,160	4,970

The assumed exploration, development, and production activities are expected to generate job opportunities for workers residing in the North Slope, other areas of Alaska, and outside Alaska. The jobs shown in **Table 3.4.10-1** are total jobs that could be available for workers from any region including outside of Alaska. It is uncertain at this time, how many workers from North Slope communities would participate in the direct oil and gas activities. Historically, very few North Slope residents participate in direct oil and gas activities in the North Slope. In 2016, 27.5 percent of the workers in the oil and gas extraction sector and 36.8 percent of the workers in oilfield services sector were from out of state (ADOLWD 2018). These non-resident percentages have been consistent in the last decade and it is possible that these levels will continue. However, it is also possible that with more education and training, the future composition of the oil and gas workforce could be different.

Oil field development projects in the North Slope typically require specialty tradesmen and construction workers with the skills and experience in ice roads, pipeline construction, facilities construction, and drilling. North Slope residents that live near existing oil developments have participated in oil and gas jobs such as ice road monitors, camp security and facilities operators, and subsistence representatives. The ADOLWD and the oil and gas industry have training programs geared towards developing special skills required in oilfield services. This is expected to create more employment opportunities for residents of Kaktovik, given their proximity to the program area.

<u>Population</u>

No changes to population growth rates or increased population are expected in Kaktovik as a result of migration of industry workers. Workers are expected to commute to the work camps on a rotational basis and are not expected to relocate to Kaktovik or other North Slope communities.

At the state level, there could be increases in population, particularly in Southcentral Alaska, as non-residents who will be working year-round at the oil company headquarters in Anchorage are expected to relocate to the region. Statewide population however would be affected by other economic and demographic factors and would be hard to predict.

<u>Labor Income</u>

The estimated labor income effects resulting from exploration, development, and production of oil resources in the Coastal Plain region are presented in **Table 3.4.10-2**. The table shows direct and indirect annual average and peak labor income by phase.

Table 3.4.10-2
Projected Direct and Indirect Labor Income: Exploration, Development, and Production Phases

Labor Income (millions of dollars 2017)	Annual Average	Peak
Direct Effects		
Exploration	$29	$77
Development	$97	$140
Production	$125	$197
Indirect Effects		
Exploration	$10	$30
Development	$214	$307
Production	$212	$307

As noted above, it is uncertain at this time how much of this total potential labor income would accrue to the local workforce, regional workforce, and Alaska workforce. Currently, about 36 percent of the total wages and salaries in the oil and gas extraction sector and 28 percent of wages and salaries in the oilfield services sector go to out-of-state workers (ADOLWD 2018). It is possible that these percentages could change over time.

Economic Sectors

Industry spending during the exploration, development, and production phases would increase the level of activity in the Alaska economy not just in the oil and gas extraction sector but also in other economic sectors including-- oil field support services; construction; engineering, environmental and other professional technical services; air, water, ground, and pipeline transportation sectors; retail and wholesale trade sectors; rental and leasing sectors; warehousing; accommodations and food services; as well as in the communications, IT support, management, and other business support sectors.

Government Revenues

Petroleum development in the program area is expected to generate revenues to the NSB government, the State, and the federal government from royalties, income taxes, production taxes, and property taxes. The projected annual average and total government revenues by type of revenue are presented in **Table 3.4.10-3**. The total represents the estimated revenues through the year 2050. Property taxes would start accruing during the development or construction phase while royalties and other taxes would be generated during the production phase.

Table 3.4.10-3
Projected North Slope Borough, State, and Federal Government Revenues

Government Revenues (in millions of dollars, 2017)	Annual Average	Total
NSB Property Taxes	$52	$1,192
State Royalties	$894	$21,463
State Taxes	$2,151	$49,473
Federal Royalties	$894	$21,463
Federal Taxes	$462	$11,082

At the local level, the City of Kaktovik could benefit from bed tax revenues with higher hotel occupancy during the initial years of development while local consultations are likely going to occur and while mobilization of construction equipment would be occurring, and even during operations. The City of Kaktovik has just started implementing a 12 percent bed tax for hotel/motel accommodations. The change in the level of hotel occupancy is difficult to quantify at this point because the timing and amount of local consultations and mobilization activities are uncertain and may vary.

At the regional level, the NSB government is anticipated to benefit from property tax revenues. Property tax payments would start to accrue during the construction phase. The State imposes oil and gas property taxes at a rate of $20 million. A local tax is levied on the state's assessed value for oil and gas property within the borough and is subject to local property tax limitations. The current NSB property tax rate is $18.5 million (the state portion of the property tax is $1.5 million). Total NSB property tax revenues through the year 2050 are estimated to amount to about $1,192 million (in 2017 dollars).

At the State level, there are several potential sources of revenues that could be generated from petroleum development in the program area. State government revenues during the production phase would include royalty payments, corporate income tax payments, severance tax payments, and continuation of property tax payments. The property tax payments would be based on the assessed valuation of the facilities developed onsite. The state property tax rate is $20 million. A local tax is levied on the State's assessed value for oil and gas property within a city or borough and is subject to local property tax limitations. The current NSB property tax rate is $18.5 million, hence, the state portion of the property tax is $1.5 million. State corporate income tax is calculated as 9.4 percent of the Alaska share of worldwide income for each corporation. The model however, does not take into consideration corporate worldwide income (which is unknown at this time) but simply evaluates all the costs and revenues and the resulting state income tax given the 9.4 percent income tax rate. Severance tax or production tax payments are based on the current tax rate of 35 percent of the production value which is the value at the point of production, less all qualified lease expenditures (net value). Qualified lease expenditures include certain qualified capital and operating expenditures. Total estimated state taxes and royalties are shown in **Table 3.4.10-3**.

Any additional oil production in the North Slope extends the life of the Trans-Alaska Pipeline System and benefits the State through higher oil revenues. Oil revenues are dependent on the oil production levels and the price of oil at the wellhead. Higher TAPS throughput results in lower pipeline tariffs and higher wellhead value. The State would benefit from higher revenues resulting from oil production in the region.

The assumed federal royalty rate is 16.67 percent of the wellhead value for oil. It is anticipated that 50 percent of the federal royalties are shared with the State. Potential annual average state royalties could amount to about $894 million.

The federal government would also receive bonus bids and rental payments from leasing; these payments cannot be quantified because there is not enough specificity at this time regarding the lease terms. Other government revenues expected to accrue during the construction phase include right-of-way payments and gravel royalties; these estimates are not available at this time.

Local Public Infrastructure and Local Businesses

Given that the oilfield workers will be housed in work camps located at the CPFs and drill pads, and away from the community of Kaktovik, there will be no anticipated increase in demand for local services and other public infrastructure in the community of Kaktovik.

Consultations and mobilization efforts during leasing, permitting, exploration, and through the development phase could potentially increase the number of people going in and out of the community and these could create temporary increases in demand for accommodations, travel services, retail services, and other personal services.

Local businesses including KIC and its subsidiaries, could potentially benefit from participation in oil and gas activities occurring during the exploration, development, and production of petroleum resources in the Coastal Plain region

Alternative B

The economic effects under Alternative B would be similar in magnitude to the economic effects discussed in the section above. There could be unquantifiable differences in the level of economic effects however, because of the ROPs associated with the various stipulations under Alternative B, including:

- Additional consultations with local, state, and federal stakeholders;
- Additional studies that would be required for permitting;
- Delays in exploration and development activities due to closures of certain environmentally sensitive areas;
- Reductions in surface disturbance;
- Additional facilities that could be required to address limited road access to the central processing facilities; and
- Additional infrastructure (i.e. bridges) that could be required to avoid environmentally sensitive areas.

Some of these actions could result in higher employment and income effects due to additional expenditures that would be necessary to be in compliance with the standard operating procedure, including additional spending on consultation, studies, and required orientation programs. Some of these actions could also result in delays in exploration, development, and production activities and would therefore also delay potential employment and income effects as well as revenues that could accrue to the local, state, and federal governments. For example, some of the stipulations could result in deferred revenues and taxes due to delays in drilling, or lower taxes and revenues due to increased costs which reduce severance taxes and profits.

The economic effects that would result from these specific actions are difficult to quantify at this time since the level and timing of activities could vary depending on how oil companies would react given the various stipulations.

Alternative C

The economic effects under Alternative C would be similar in magnitude to the economic effects discussed in the section above. As noted above, there could be differences in economic effects resulting

from the various stipulations, but these effects would be difficult to quantify at this time since the level and timing of activities could vary depending on how each industry player would react given the various stipulations under this alternative.

Alternative D

The economic effects under Alternative D would be similar in magnitude to the economic effects discussed in the section above. However, the higher level of restrictions under this alternative could reduce the amount of oil produced, and defer or reduce potential government revenues and taxes, and result in lower economic benefits relative to the other action alternatives.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions are presented in **Appendix M**, Approach to the Environmental Analysis. Oil production from the North Slope is projected to decline from 522,000 barrels per day in FY 2018 to 493,000 barrels per day in FY 2027 as production from existing fields continue to decline (ADNR 2018). Production from newer development projects such as Point Thomson, GMT1, and GMT2 are expected to contribute to oil production in the next 10 years. Point Thomson was brought online in April 2016 with production facilities designed to produce and re-inject (cycle) 200 million cubic feet per day of gas and produce up to 10,000 barrels per day of natural gas condensate. This project opens the eastern North Slope to development and would lead to increased production into TAPS. Project construction for GMT1 is well underway and will continue next winter, with first oil planned for late 2018. Peak workforce at GMT1 during construction is estimated to be 700 and the estimated peak monthly production is estimated to be 30,000 barrels of oil per day (gross). GMT2 could begin construction in the winter of 2018/2019, with first oil planned for late 2021. The development plan is for up to 48 wells, with 36 wells being permitted initially. The project is estimated to cost $1.5 billion to develop and peak production is expected to be 25,000 to 35,000 barrels of oil per day.

The oil and gas leasing program and subsequent exploration, development, and production activities in the program area will increase oil production in the North Slope and increase TAPS throughput, increase economic activity at the local, regional, and state level due to direct industry spending on labor, materials, and services, increase government revenues from shared royalties, tax payments such as property taxes, corporate income taxes, severance taxes, and other local taxes, increase job opportunities for Alaskans, including residents of communities in the NSB, and increase labor income in regions where industry spending would occur and where the oil and gas workforce resides.

There will be no additional economic effects under Alternative A since there will be no petroleum development without leasing. The impacts to the economy under the action alternatives would be similar; however, there may be differences in employment, income, and revenues due to differences in how the various stipulations under each of the action alternatives would affect industry response and spending.

Climate change could negatively impact the economy of the North Slope because villages are primarily located at or near sea level, any increase in mean sea level or violent storms may require relocation of part or all of villages and subsistence camps. This would have a negative economic impact to the villages and the NSB, and to the state if relocation of villages were to occur.

3.4.11 Public Health

Affected Environment

The BLM NPR-A Integrated Activity Plan/EIS (2012) analyzed the public health status in the NSB based on demographic and health infrastructure through 2010; is incorporated by reference in this EIS (BLM 2012, Section 3.4.12). The BLM analysis considers all eight villages of the NSB, a broader perspective than the analysis for this EIS, which focuses primarily on the village of Kaktovik, due to its proximity to the program area.

Under NEPA regulations, projects that require an EIS must include an analysis of health impacts associated with federal actions. The discussion below is consistent with recent NEPA analyses on the North Slope by including a broad description of health conditions (BLM 2012). The wider scope of analysis results from changing expectations for what constitutes a sufficient examination of human health within the regulatory process. North Slope residents, the NSB municipality, and others have advocated strongly for the inclusion of a more systematic and broad-based appraisal of human health concerns in the planning process. This was corroborated by comments received during the scoping period. This EIS does not analyze specific developments in the program area; therefore, a health impact assessment was not completed for this analysis. Health impact assessments are expected to be developed for future development projects that will require additional NEPA analysis.

Oil and gas development has had mixed impacts on the North Slope. Specific to oil and gas development, the NSB Baseline Community Health Analysis Report (2012, page 45) provides the following commentary:

> The health impacts of oil and gas development in the North Slope Borough are complex, as it has touched many aspects of community life in the region. Following the formation of the North Slope Borough, oil and gas revenues have created employment opportunities, provided money for essential services and infrastructure, and raised the average household income. An influx of outside interests and money can also create conflict, alter social structure, and divide communities, affecting community well-being. Real and potential impacts on the environment and subsistence are also ongoing sources of tension and concern.

The following descriptions summarize baseline public health data for the NSB and Kaktovik, the community closest to the program area.

Accidents and Injuries

Accidents and injuries are an important cause of injury and death in Kaktovik and the North Slope in general. Off-road vehicles accounted for 18 percent of injury deaths among North Alaska Natives, most which are snowmachine accidents (AN EpiCenter 2009). Motor vehicle accidents are not common in Kaktovik, due to the limited road system (NSB 2014).

Suicide was the leading cause of injury death for the NSB between 1999 and 2005, comprising 39 percent of all injury deaths. This is among the highest suicide rates in Alaska, at 73.5 deaths per 100,000 (AN EpiCenter 2009).

Food, Nutrition, and Subsistence Activity

Subsistence is important for the people of Kaktovik for both food and cultural sustenance (see **Section 3.4.3**, Subsistence Uses and Resources). The village's subsistence area extends into the program area and adjacent land and waters bounded to the south by the headwaters and the tributaries of the Hulahula, Jago, and Salderochit Rivers, west to the Sagavanirktok River and Dalton Highway, east to Demarcation Bay, and north about 60 miles in the Beaufort Sea.

Kaktovik's primary subsistence resources are caribou, sheep, bowhead whale, bearded seal, fish, and waterfowl (NSB 2014). Approximately 60 percent of the subsistence harvest consists of marine mammals. Kaktovik residents hunt for bowhead whales from July to September in offshore areas between 15 and 30 miles from shore, between Camden Bay and Tapkaurak Lagoon. Bearded seal and ringed seal are other marine mammal sources; hunting occurs from March to September, with most success in July and August between Prudhoe Bay and Demarcation Bay, with a maximum distance of 30 miles from the shore.

Caribou are another primary source of subsistence harvest and are hunted along the coast during the summer by boat and inland during the winter by snowmachine. Caribou can be hunted year-round, but mostly during July and August, when the caribou are in their prime condition. Arctic cisco and Arctic char/Dolly Varden are the primary fish species and are harvested primarily in July and August, during the summer migration of the fish along the coast from the Mackenzie River to the Colville River (NSB 2014).

According to 2015 NSB census data, 42 percent of Kaktovik Iñupiat residents depended on subsistence foods for over half of their diet, and 13 percent of Kaktovik Iñupiat households depended on subsistence foods for almost all their diet. Sharing the harvest is an important objective in subsistence lifestyles; 42 percent of households shared half or more of their harvests with others in the community (NSB 2015).

Food security is a concern of NSB households, particularly Iñupiat households. In the 2015 NSB census, 37 percent of household heads reported difficulty getting healthy food for meals and 25 percent reported that there were times when there was not enough food to feed the household (NSB 2015). For Kaktovik residents, 10 percent of household heads reported there were times when there was not enough food for the household. Most NSB household heads (71 percent) indicated that this was due to a lack of store-bought foods (NSB 2015).

Exposure to Potentially Hazardous Materials

Residents of the NSB are concerned about environmental contamination, particularly as it relates to contamination of subsistence food sources. In a recent survey, 44 percent of Iñupiat village residents reported concerns that fish and animals may be unsafe to eat (Poppel et al. 2007).

Air quality concerns in rural Alaska villages include diesel emissions, indoor air quality, road dust, solid waste burning, and wood smoke. NSB residents are also concerned about air pollution generated by oil and gas activities. Assessments of air pollution in Nuiqsut, 173 miles west of Kaktovik, have found that pollutant concentrations are generally well below the national ambient air quality standards (BLM 2018). Researchers also sampled air and water for volatile organic compounds in Nuiqsut. Over half of the air samples included volatile organic compounds, but none exceeded federal and Alaska air quality

standards. None of the water samples had volatile organic compound levels that exceeded Alaska Department of Environmental Conservation standards (BLM 2018).

The Alaska Department of Environmental Conservation identified 22 potentially contaminated sites in Kaktovik. These sites include former landfills and dump sites, the tank farm terminal, and DEW Line network facilities. Five of the sites are still active; the cleanup for the remaining 17 sites has been completed (ADEC 2018).

Public Utilities and Services

Public utilities are an important component of community health and wellness. Safe drinking water and sewage treatment prevent the spread of many serious transmissible diseases. Insufficient heating has been linked with poor health outcomes, particularly in children and older people (BLM 2012).

The NSB provides utilities for all Kaktovik. Public facilities include water and sewer treatment plants and a landfill. Kaktovik's infrastructure has had several upgrades in recent years. A buried water and sewer treatment system for the village was completed in 2003. Freshwater sources include small thaw lakes and ponds, a few deep stream channels, and Fresh Water Lake, which is about 0.7 miles from the village. Water is pumped in the summer into the treatment plant and then into two storage tanks for winter use (NSB 2014). Ninety-nine percent of Kaktovik residents have running water, compared to 92 percent for the NSB (NSB 2012).

The NSB operates a small power plant on the west side of Kaktovik. The facility generates electricity using diesel fuel and distributes electricity to the village through aboveground utility lines. The power plant is relatively new and should be sufficient for the next 15 to 25 years, assuming normal maintenance and upgrades (NSB 2014).

Health Services Infrastructure

The NSB and the Arctic Slope Native Association are jointly responsible for delivering health services to residents. Kaktovik maintains a clinic that is staffed by medical personnel via the Community Health Aide Program. This clinic does not have a physician or physician's assistant in residence. The closest hospital to Kaktovik is the Samuel Simmonds Memorial Hospital in Utqiagvik, 311 miles northwest. Cases are referred to Fairbanks or Anchorage if they cannot be adequately treated in Utquagvik (BLM 2012).

The leading clinical assessments made by community health aides in the NSB villages including Kaktovik in 2005-2006 include respiratory or ear-nose-throat problems, injuries, and preventative care (NSB 2012). The primary outpatient visit diagnoses at Samuel Simmonds Memorial Hospital were managing chronic health conditions, such as high blood pressure, diabetes, and arthritis, and treating acute respiratory infections (NSB 2012).

Direct and Indirect Impacts

This section describes the potential direct and indirect impacts of the proposed oil and gas leasing program on public health and safety. Proposed oil and gas leasing may lead to alterations in public health and safety via a number of different pathways. These include safety, diet and nutrition, environmental contaminants, economic impacts, and public health services.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales following the ROD for this EIS. Alternative A would not include the direction under the Tax Cuts and Jobs Act of 2017 to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain within the Arctic Refuge. Under this alternative, current management actions would be maintained and resource trends would continue, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (USFWS 2015).

Under Alternative A, no impacts to public health and safety would occur from oil and gas development in the program area and Kaktovik residents would maintain their current lifestyle. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of the Tax Act, including the requirement to hold multiple lease sales and to permit associated post-lease activities. However, Alternative A is being carried forward for analysis to provide a baseline for the comparison of impacts under the action alternatives.

Impacts Common to All Action Alternatives

This section discusses impacts to public health and safety which are common to all alternatives. Common types of direct and indirect effects to public health associated with oil and gas development within the program area include changes in subsistence harvest patterns; increased travel time for subsistence harvesting; changes in air and water quality and noise pollution, increases in Kaktovik resident, village of Kaktovik, and North Slope Borough revenue; and changes in public health service usage and access.

This section does not include a Health Impact Assessment; the Coastal Plain Oil and Gas Leasing Program EIS analyzes various leasing alternatives and does not analyze specific developments. Health Impact Assessments would be utilized during future NEPA analysis of specific projects after the lease sales are complete.

<u>Safety</u>

Indigenous populations in the Arctic and elsewhere have very high rates of accidents and trauma. Clinical assessments at the Kaktovik clinic include a high percentage of injuries and accidents (NSB 2012). The high incidence of accidents is partly due to the risks associated with subsistence activities, especially given the hostile environment of northern Alaska (BLM 2012).

Oil and gas development in the program area has the potential to increase the risk of injuries and accidents during subsistence activities. Oil and gas development in the program area is expected to impact caribou herd movements and alter subsistence hunting patterns for Kaktovik residents (see **Section 3.4.3**, Subsistence Uses and Resources). The disturbance of wildlife by industrial activity is likely to result in hunters traveling further afield and possibly into unfamiliar terrain to harvest stocks.

Oil and gas development is not expected to increase the Kaktovik road system from its current extent but would develop permanent and seasonal roads in the program area. If Kaktovik residents have easy access to project roads, it is likely that some will use the roads to access subsistence harvesting areas, particularly during times when overland snowmachine travel is difficult. As oil and gas development expands and road travel rises, so will the risk of motor vehicle accidents and injuries (BLM 2012).

Under all the action alternatives, the main impact on accidental injuries would result from either altered travel patterns or increased travel time for subsistence activity. Under all the action alternatives, development of fixed facilities in areas of traditional use is likely to result in voluntary displacement of subsistence. This impact would be greatest significant if large numbers of hunters avoid territory close to Kaktovik. All action alternatives have the same potential for development close to the village of Kaktovik.

<u>Diet and Nutrition</u>

Health impacts resulting from changes in diet and nutrition are a major concern when oil and gas developments affect populations reliant on subsistence resources. Dietary changes may result from the displacement or contamination of food sources, avoidance or loss of traditional harvesting lands, and increased reliance on store-bought foods. Consumption of traditional foods is associated with reduced risk of chronic diseases such as diabetes, hypertension, cardiovascular disease, and stroke (BLM 2012). Store-bought food in rural Alaskan villages tends to have low nutritional value and the cost of buying nutritious foods is often prohibitively expensive. When subsistence resources become less accessible and people rely more heavily on store-bought foods, the nutritional value of the diet decreases and the risk of chronic diseases increases.

In addition, 10 percent of Kaktovik household heads reported times when there was not enough food for their household (NSB 2015). Studies have found a variety of adverse health impacts from food insecurity including obesity, poor psychological functioning among children, poor cardiovascular health, and lower physical and mental health ratings. The costs associated with harvesting subsistence resources, the year-to-year variability in subsistence harvest, and the high cost of store-bought food all contribute to high rates of food insecurity.

The likelihood of impacts to subsistence harvests under all action alternatives is discussed in **Section 3.4.3,** Subsistence Uses and Resources. Impacts to caribou migratory patterns and avoidance of development areas are expected from oil and gas development. Kaktovik residents are also likely to avoid areas of heavy development. Perceived and actual threats to subsistence activities and harvest patterns are a primary source of ongoing concern and stress in North Slope communities. Avoidance of productive land may reduce harvests and exacerbate dietary and nutritional outcomes independent of any direct impact on the animals themselves. Any reductions in the success of subsistence harvests for Kaktovik residents would accelerate the transition from subsistence resources to store-bought foods, worsening nutritional outcomes and food insecurity.

<u>Environmental Contaminants</u>

Activities associated with oil and gas exploration and development can affect human health via changes to air and water quality or an increase in noise pollution. Oil and gas activities may affect air or water quality resulting in potential increases in acute or chronic health effects or contamination of subsistence food sources.

AIR QUALITY

Air quality impacts are similar for all action alternatives as each alternative permits up to 2,000 acres of disturbance and the point sources and their locations are unknown at this point. **Section 3.2.2,** Air Quality describes the impacts of potential oil and gas development on air quality. The primary sources of airborne emissions include construction dust, road dust, vehicle and machinery emissions, flaring and

venting of gas, burning of refuse, and emissions from power generation as well as other sources. The air pollutants emitted by these activities have been linked with a range of health effects including asthma, chronic bronchitis, decreased pulmonary function, and cardiovascular events (BLM 2012).

Both the EPA and the State of Alaska have established legal limits for air pollution to protect public health (**Section 3.3.2,** Air Quality). Air quality changes are most likely to occur at and near the areas of oil and gas development. If the development areas are distant from Kaktovik, impacts to the health of Kaktovik residents as a whole are unlikely to be seen and overall impact to human health is likely to be low. Those most likely to be affected are those individuals that stay in cabins or other residences near development areas. In particular, dust from construction activities or traffic may be an issue.

Based on previous projects and studies on the North Slope, the overall impact on human health is likely to remain low as all action alternatives are likely to be below applicable air quality standards for all project phases (**Section 3.2.2,** Air Quality). However, people who are particularly vulnerable to respiratory problems (such as children, the elderly, and people with certain chronic illnesses) may experience health problems at locations or during episodes with poorer air quality.

WATER QUALITY

As described in **Section 3.2.10,** Water Resources, oil and gas development could impact water quality through accidental spills or releases or as the byproduct of construction, excavation, or human habitation. Water quality has the potential to affect health of Kaktovik residents through contamination of the village of Kaktovik drinking water or through contamination of rivers and waterways near subsistence cabins or camps.

Water contamination could occur through accidental discharges into watercourses that supply human water sources, particularly in areas of cabins or transient subsistence uses of the land. However, the likelihood of any such discharge occurring with the resultant human exposure is low, given the stipulations and best management practices around waste prevention, handling, disposal, spills, and public safety. If exposure occurred under these circumstances, the exposure would be likely short-term and intermittent, and unlikely to lead to significant health effects. No development is allowed on Barter Island, so no impacts to Kaktovik's drinking water supply are expected.

CONTAMINATION OF FOOD SOURCES

Section 3.4.3, Subsistence Uses and Resources, concludes that there is a low likelihood of contamination of subsistence food sources, with the possible exception of contamination through an oil spill. This is supported by current low measurable impacts despite high levels of oil and gas activities on the North Slope in the past. Although studies have found elevated levels of contaminants in several species, the levels found in subsistence foods in the North Slope area appear at present to be generally low and are lower than what would trigger public health concern (NSB 2006). Except in the event of a major spill (see **Section 3.2.11,** Solid and Hazardous Waste), there are likely to be only negligible health effects from contamination of food sources as a result of activities associated with any of the action alternatives.

Despite the current safety of traditional foods in the program area, Kaktovik residents remain concerned that oil and gas activities could increase contaminant loads of subsistence foods to a level that would threaten human health. Any oil and gas development is likely to reduce confidence in subsistence

food sources and possibly reduce consumption of subsistence sources. However, any decrease in subsistence food consumption would likely be below the threshold to observe any measurable changes in health outcomes. Monitoring of contaminants in subsistence foods (ROP 8 in **Chapter 2**) would help address subsistence user concerns related to contaminants and identify potential human health concerns.

NOISE

Noise levels may raise from construction or operation of oil and gas facilities resulting in potential effects ranging from minor irritation and annoyance to more severe health outcomes. Given the likely location of development away from Kaktovik, individuals at cabins or camps near developments would be most impacted. Noise from air traffic and other sources could create a nuisance around individuals' camps and cabins, possibly reducing their use as a base for subsistence harvests. Development-related noise may cause irritation, annoyance, or sleep disturbance among individuals who experience it (BLM 2012). Until site-specific development activities are proposed, the extent of this effect is not possible to determine.

<u>Economic Impacts on Health</u>

Economic growth and employment that are associated with resource development can exert impacts on the health of populations. Increased income for Kaktovik residents and families has the potential to improve health through increases in the standard of living, reductions in stress, and opportunities for personal growth and social relationships (BLM 2012). However, there are negative impacts of economic growth as well. With other oil and gas development within the North Slope Borough, income and employment have been found to be associated with an increased prevalence of social pathologies, including substance abuse, assault, domestic violence, and unintentional and intentional injuries (BLM 2012).

Most oil and gas industry jobs in the North Slope have gone to transient workers and oil and gas development in the program area is not expected to directly employ a large proportion of Kaktovik residents. The primary employment and income impacts to Kaktovik residents is anticipated to be indirect as a result of increased revenues to the North Slope Borough and village of Kaktovik, which allows for increased program spending and hiring. For a full description of socio-economic impacts, see **Sections 3.4.4,** Sociocultural Systems, and **3.4.10,** Economy.

Under all action alternatives, the increased revenue for the North Slope Borough and village of Kaktovik would allow for increased funding of existing health and social programs and an increase in indirect employment of Kaktovik residents (**Section 3.4.10,** Economy). Improvements to Kaktovik infrastructure would also be expected as a result of increased funding; possible capital projects are listed in Kaktovik's comprehensive development plan (NSB 2014).

<u>Public Health Services</u>

Oil and gas development would occur outside of Kaktovik and would be fully self-contained. Local Kaktovik health care services would not be affected by an influx of oil and gas workers as the worker camps would provide health services to the oil and gas workers. There may be a slight increase in accidents due to changes in subsistence harvesting patterns, but these would be sporadic and well within the capacity of the Kaktovik local clinic and Samuel Simmonds Memorial Hospital in Utqiagvik.

Anticipated tax revenues from oil and gas development under all action alternatives would support the current level of health care services in Kaktovik and should not impact demand. Episodic increases in disease occurrence, such as respiratory disease resulting from poor air quality, have the potential to cause short-term strain on the health care system. However, no such occurrences are likely under any of the action alternatives.

Alternative B

Under Alternative B, the types of impacts on public health and safety would be the same as those described above (Impacts Common to All Action Alternatives). The duration of all types of impacts would be long-term for the duration of operation in the program area.

Under Alternative B, 733,100 acres of caribou calving habitat would be available for leasing, which would result in the greatest potential impact to calf survival and overall porcupine caribou herd numbers out of all alternatives. Caribou is a primary subsistence species for Kaktovik residents. Any real or perceived threat to caribou herd numbers or contamination of caribou meat would increase the likelihood and severity of health impacts resulting from changes in diet and nutrition and would exacerbate the current trends away from a traditional diet. In addition, changes to caribou herd numbers or movement would potentially increase the distance and time that Kaktovik hunters travel and increase the potential for accidents or injury.

Alternative C

The types of impacts under Alternative C would be the same as those described under Alternative B. Under Alternative C, fewer acres of caribou calving grounds would be offered for sale (476,600 acres) or allowed surface occupancy (126,900). In addition, Alternative C would impose greater timing restrictions on human activity within the porcupine caribou herd post calving habitat area than Alternative B. Real and perceived impacts to the porcupine caribou herd numbers would be reduced under Alternative C compared with Alternative B reducing the potential for impacts to diet and nutrition from reductions in subsistence harvests.

Alternative D

The types of impacts under Alternatives D1 and D2 would be the same as those described under Alternative B; however, the intensity of subsistence impacts would be substantially less under Alternatives D1 and D2. Less than half of the calving grounds offered for sale under Alternative B would be offered for sale under Alternatives D1 and D2, and more lands would be subject to development and timing restrictions. Alternative D-2 would be somewhat less likely to affect subsistence uses and resources when compared to Alternative D-1 because of the greater restrictions under Alternative D-2 on development within caribou summer habitat. Protection of caribou calving areas would decrease the likelihood of diet changes and slow the trend from traditional foods to store-bought food.

Cumulative Impacts

As described in **Appendix M**, Approach to the Environmental Analysis, there are a significant number of activities planned and/or approved on the North Slope Borough and the program area. The village of Kaktovik and its residents have been buffered by the surrounding Arctic Refuge, which has limited oil and gas development in the immediate vicinity. Air and water quality in and around the village remains relatively untouched, subsistence harvests have not been noticeably affected, and the influx of oil-and-gas revenue for the North Slope Borough has improved infrastructure within the village. There is still a high

rate of accidents and injury primarily due to subsistence activities and food security for Kaktovik households remains a concern.

Future development offshore in the Beaufort Sea could impact Kaktovik residents by interfering with marine mammal movement patterns. This could increase the risk of accident and injury by changing the subsistence harvest patterns and requiring more time on the water to harvest animals. In addition, the success rate for harvesting marine mammals may decline, reducing subsistence food for Kaktovik households and increasing food security concerns.

Further disruptions to subsistence patterns from global environmental and climatic changes could foreseeably have adverse effects on Kaktovik resident health including changes to subsistence harvests; see **Section 3.4.3,** Subsistence Uses and Resources, for a discussion of potential effects of climate change on subsistence harvesting. Changes to subsistence migration patterns and changing weather patterns and sea ice conditions could make travel more hazardous increasing the risk of injury and trauma. Wide spread melting of permafrost would impact Kaktovik residents' ability to store meat in deep cellars. This would increase the amount of spoiled food and the potential for food-borne illness (USACE 2012).

The action alternatives would have similar contributions to the cumulative effects on public health for Kaktovik residents with the pathways described above. All action alternatives would continue the ongoing transition from a subsistence-based diet to one that includes store-bought food as oil-and-gas development would potentially interfere with the success of subsistence activities. Alternatives C and D would lessen the potential negative impacts of oil and gas development by protecting the porcupine caribou herd calving range of the porcupine caribou herd as well as including timing restrictions in post-calving range and insect relief areas and larger buffers on important waterways and the coastal area. Alternative B would allow the most widespread industrial activity with resulting impacts to subsistence harvest efforts and could result in an acceleration of the transition away from a traditional diet and the subsequent increases in health risks.

Current levels of contamination of traditional food and water supplies in the region are low and, in the absence of major spills or accidents, are unlikely to significantly change under any action alternative. However, perception of contamination is already high. Oil-and-gas development, particularly in areas of traditional use and subsistence harvest as would be the case under Alternative B, would increase the perception of contamination and may result in changes in consumption patterns.

Rates of accident injury are very high for Kaktovik residents. Disruptions to subsistence harvest patterns and conflicts between uses of the land can lead to an increased risk of injury in hunters. This is in addition to the risk of unpredictable weather and sea ice conditions associated with climate change. All action alternatives would increase the likelihood of injury due to industrial use of land previously used only for subsistence activity.

Increasing economic development and revenues to the local governments under all the action alternatives would support maintenance and improvement of Kaktovik infrastructure and systems. The direct and indirect employment resulting from oil and gas exploration and development combined with the government and Native corporation revenues are all major contributors to the positive health changes in the North Slope Borough over the last few decades. The activities under all action

alternatives would provide substantially to these ongoing benefits, with greater levels of employment generally being more likely to be associated with good health.

3.5 UNAVOIDABLE ADVERSE EFFECTS

Unavoidable adverse effects would be expected to occur during oil and gas exploration, development, and production operations. Many adverse impacts could be lessened by mitigation but would not be completely eliminated or reduced to negligible levels. Some are short term impacts, while others may be long term impacts. These have been described for each resource in **Sections 3.2 to 3.4**. Depending on the location and extent of oil and gas operations and adopted mitigation, unavoidable adverse impacts could potentially include:

- Loss of soil productivity and sand and gravel resources largely from construction of roads and pads and gravel mine development
- Loss of petroleum resources
- Increased risk of spills
- Changes in surface flow and drainage patterns due to construction of roads and pads and surface water withdrawal for ice roads, dust abatement, and operations
- Loss of vegetation habitat including wetlands due to construction of roads and pads and gravel mine development
- Loss, alteration, or fragmentation of wildlife habitat
- Changes in wildlife migration or travel patterns
- Continued change in access to and availability of subsistence resources

Oil and gas leasing regulations (43 CFR 3104) require, prior to commencement of surface disturbing activities, the operator on the ground shall be covered by a bond. This bond provides monetary assurance to BLM that the company will reclaim the pads, wells, and any associated surface disturbance to the standards of the BLM authorized officer. This is determined at the time of reclamation, thus allowing BLM to take an adaptive management approach. Upon abandonment, BLM will consider current data, technologies available, and the current resource situation in its determinations on specific reclamation. Additionally, BLM retains the ability to increase the bond amount at any time during the lease based on a recalculation of liability (i.e., increased number of wells, or a history of non-compliance with BLM's operational standards).

3.6 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

This section discusses the short-term effects of the leasing alternatives, including the potential use of the program area for oil and gas exploration and development activities, versus the maintenance and enhancement of potential long-term productivity of the program area's environmental resources.

Short term in this discussion refers to the total duration of activities that could occur as a result of the leasing alternatives, primarily oil and gas exploration and production activities, whereas long term refers to an indefinite period extending beyond the termination of the action. Specific impacts vary in kind, intensity, and duration according to the activities occurring at any given time. Activities during the production life of oil and gas leases executed based upon the decision in the Coastal Plains record of decision may result in chronic impacts over a longer period of time. Over the long term—several

decades after completion of abandonment activities— natural environmental balances are generally expected to be restored, though that balance will not for all resources mean a return to the exact state prior to original disturbance.

For a discussion of short-term uses of the program area for hydrocarbon development and production activities versus the maintenance and enhancement of potential long-term productivity of environmental resources of the program area, see Sections 3.2 to 3.4 of this document and Section 4.9 of the NPR-A EIS (BLM 2012) for a description of environmental resources on the North Slope.

3.7 Irreversible and Irretrievable Commitments of Resources

Irreversible or irretrievable commitments of resources refer to impacts or losses to resources that cannot be reversed or recovered. These distinctions refer primarily to non-renewable resources. A detailed description of irreversible or irretrievable commitments of resources from oil and gas development on the North Slope is included in Section 4.10 of the NPR-A EIS (BLM 2012). There would be some irreversible or irretrievable commitments of resources that are described in greater detail in **Sections 3.2** to **3.4**. These include:

- Removal of hydrocarbons from the reservoir
- Energy consumption associated with construction and operation of the project
- Ground disturbance and permanent change resulting from gravel removal
- Surface water consumption for drilling and other industrial purposes with wastewater disposal via underground injection
- Loss or change in vegetation and wetlands where gravel is placed, regardless of whether it is removed at abandonment
- Loss or abandonment of wildlife habitat
- Loss or change in subsistence use of the program area, depending on final abandonment plans

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None.

Chapter 2

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Glossary

Acidophilus: Acid-loving (as in bacteria or plants); growing well in an acid medium.

Active floodplain: The flat area along a waterbody where sediments are deposited by seasonal or annual flooding; generally demarcated by a visible high water mark.

Aerial: Consisting of, moving through, found in, or suspended in the air.

Alluvial: Sedimentary material consisting mainly of coarse sand and gravel.

Alternatives: The different means by which objectives or goals can be attained. One of several policies, plans, or projects proposed for decision making.

Ambient: A term used to describe the environment as it exists at the point of measurement and against which changes (impacts) are measured.

Ambient air quality standard: Air pollutant concentrations of the surrounding outside environment that cannot legally be exceeded during fixed time intervals within a specific geographic area.

Amphidromous: A term used to describe fish that spawn and overwinter in rivers and streams, but migrate during the ice-free summer from these freshwater environments into coastal waters for months to feed.

Anadromous: A term used to describe fish that mature in the sea and swim up freshwater rivers and streams to spawn. Salmon, steelhead, and sea-run cutthroat trout are examples.

Anchor field: An oil and gas field containing sufficient quantities of recoverable oil and gas to support the construction of infrastructure and processing facilities, satellite fields can then be constructed using the anchor field facilities.

Anticline: An inverted bowl-shaped structure formed when sedimentary rock layers are folded to produce an arch or elongated dome.

Anoxic: The condition of an environment in which free oxygen is lacking or absent.

Anthropogenic: Of, relating to, or resulting from the influence of human beings on nature.

Aquatic: Growing, living in, frequenting, or taking place in water; in this IAP/EIS, used to indicate habitat, vegetation, and wildlife in freshwater.

Archaeological resource: Place(s) where the remnants (e.g., artifacts) of a past culture survive in a physical context that allows for the interpretation of these remains. Archaeological resources can be districts, sites, buildings, structures, or objects and can be prehistoric or historic in nature.

Aufeis: Thick ice that builds up as a result of repeated overflow.

Authorized Officer (AO): Designated agency personnel responsible for a certain area of a project; for the National Petroleum Reserve-Alaska, generally the BLM State Director.

Available: When referring to oil and gas leasing, available lands could be offered for oil and gas leasing. Lands that are already leased could be offered for leasing if the existing lease ceases to exist.

Barrel: Unit of measurement consisting of 42 gallons of oil or other fluid.

Baseline data: Data gathered prior to the proposed action to characterize pre-development site conditions.

Biodegradable: Capable of being broken down by the action of living organisms such as microorganisms.

Biological Assessment (BA): A document prepared by or under the direction of a federal agency; addresses listed and proposed species and designated and proposed critical habitat that may be present in the action area, and evaluates the potential effects of the action on such species and habitat.

Black water: Discharge that includes wastewater from any or all of the following: toilets, urinals, sewage treatment systems.

Bonding capacity: An amount, determined by market analysts, based on a government entity's prior bonding experience, actual repayment performance, and its ability to service future, periodic debt. It affects the ability of municipalities to issue and sell bonds to generate funds for capital improvements.

Bore-hole: The opening in the ground that is created when drilling a well; may refer to the inside diameter of the bore-hole wall, the rock face that bounds the drilled hole.

Bottomfast ice: Ice that is firmly attached or grounded to the bottom of a waterbody, which is often frozen from top to bottom.

Brackish: Water that is intermediate between salt and fresh water; often occurs at the mouths of rivers, where fresh water mixes with salt water.

Brine: General description of water that is produced with oil. The water is associated with the oil-producing formation and can have varying amounts of dissolved salts.

Brood: A group of young birds being cared for by an adult bird; generally the surviving hatchlings from one or more clutches of eggs.

Bureau of Land Management (BLM): An agency of the United States government, under the U.S. Department of the Interior, responsible for administering certain public lands of the United States.

Burin: A tool flaked into a chisel point for inscribing or grooving bone, wood, leather, stone, or antler.

Calving area: A large area where large mammals, particularly ungulates such as caribou, congregate to give birth to their young.

Capital expenses: The money spent to purchase or upgrade physical assets, such as buildings or machinery.

Carrion: Dead or dying flesh of animals.

Class I air quality area: One of 156 protected areas such as national parks (over 6,000 acres), wilderness areas (over 5,000 acres), national memorial parks (over 5,000 acres), and international parks that were in existence as of August 1977, where air quality should be given special protection. Federal Class I areas are subject to maximum limits on air quality degradation called air quality increments (often referred to as Prevention of Significant Deterioration [PSD] increments). All areas of the United States not designated as Class I are **Class II** areas. The air quality standards in Class I areas are more stringent than national ambient air quality standards.

Council on Environmental Quality (CEQ): An advisory council to the President of the United States; established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA): An act that provided the authority for money administered by the Environmental Protection Agency to identify and clean up hazardous waste sites; also known as Superfund.

Code of Federal Regulations (CFR): A codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government.

cfs: Cubic feet per second; 1 cfs equals 448.33 gallons per minute.

Commercial field: Oil or natural gas fields that can be produced such that they provide a suitable return on investment.

Commercial oil (or natural gas) reserves: Oil or natural gas reserves that can be produced such that they provide a suitable return on investment.

Commercially recoverable: See commercial oil (or natural gas) reserves.

Concern: A point, matter, or question raised by management or the public that must be addressed in the planning process.

Conglomerate: Sedimentary rock consisting of gravel and small boulders.

Consistency determination: A finding by a state or federal agency that a project or agency action is consistent with a required agency program, guideline, or regulation, such as the Alaska Coastal Zone Management Program.

Consultation: Exchange of information and interactive discussion; when the "C" in consultation is capitalized it refers to consultation mandated by statute or regulation that has prescribed parties, procedures, and timelines (e.g., Consultation under NEPA or section 7 of the Endangered Species Act).

Controlled Surface Use (CSU): A category of moderate constraint stipulations that allows some use and occupancy of public land while protecting identified resources or values and is applicable to fluid mineral leasing and all activities associated with fluid mineral leasing (e.g., truck-mounted drilling and geophysical exploration equipment off designated routes, and construction of wells and pads). CSU areas are open to fluid mineral leasing, but the stipulation allows the BLM to require special operational constraints, or the activity can be shifted more than 200 meters (656 feet) to protect the specified resource or value.

Criteria: Data and information that are used to examine or establish the relative degrees of desirability of alternatives or the degree to which a course of action meets an intended objective.

Criteria air pollutants: The six most common air pollutants in the U.S.: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO2), ozone (O3), particulate matter (both PM10 and PM2.5 – inhalable and respirable particulates), and sulfur dioxide (SO2). Congress has focused regulatory attention on these six pollutants because they endanger public health and the environment, are widespread throughout the U.S., and come from a variety of sources. Criteria air pollutants are typically emitted from many sources in industry, mining, transportation, electricity generation, energy production and agriculture.

Cultural resources: The remains of sites, structures, or objects used by humans in the past, historic or prehistoric. More recently referred to as heritage resources.

Cumulative effects or impacts: The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant actions, taken place over a period of time.

Deferred: When referring to oil and gas leasing, deferred indicates that lands would not be offered for lease until a specified period has expired. For example, a ten-year deferral would mean that the deferred lands would not be offered for leasing until the expiration of ten years from the Record of Decision establishing the ten-year deferral.

Demersal: Living near, deposited on, or sinking to the seabed.

Density: The number of individuals per a given unit area.

Deposit: A natural accumulation, as of precious metals, minerals, coal, gas, and oil that may be pursued for its intrinsic value; gold deposit.

Development: The phase of petroleum operations that occurs after exploration has proven successful, and before full-scale production. The newly discovered oil or gas field is assessed during an appraisal phase, a plan to fully and efficiently exploit it is created, and additional wells are usually drilled.

DEW-Line: Distant Early Warning-Line. A site designed and built during the Cold War as the primary line of air defense warning of "Over the Pole" invasion of the North American Continent.

Dilution: The act of mixing or thinning, and therefore, decreasing a certain strength or concentration.

Dispersion: The act of distributing or separating into lower concentrations or less dense units.

Dissociable: Able to break up into simpler chemical constituents.

Diversity: An expression of community structure; high if there are many equally abundant species; low if there are only a few equally abundant species. The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Draft Environmental Impact Statement (DEIS): The draft statement of the environmental effects of a major federal action, which is required under section 102 of the National Environmental Policy Act, and released to the public and other agencies for comment and review.

Drilling fluid (mud): A preparation of water, clay, and chemicals circulated in a well during drilling to lubricate and cool the drill bit, flush rock cuttings to the surface, prevent sloughing of the sides of the hole, and prevent the flow of formation fluids into the bore-hole or to the surface.

Drill pad: A drilling site, usually constructed of local materials such as gravel.

Duck pond: A small, flat-bottomed plastic receptacle placed under a vehicle to catch and contain any contaminated fluids that may melt or drip from the underside of the vehicle.

Economically recoverable: See commercially recoverable.

Effect: Environmental change resulting from a proposed action. Direct effects are caused by the action and occur at the same time and place, while indirect effects are caused by the action, but are later in time or further removed in distance, although still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems. Effect and impact are synonymous as used in this document.

Employment: Labor input into a production process, measured in the number of person-years or jobs; the number of jobs required to produce the output of each sector. A person-year is approximately 2,000 working hours by one person working the whole year or by several persons working seasonally. A job may be 1 week, 1 month, or 1 year.

Endangered species: Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range; plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.

Energy budget: The flow of energy through an organism or ecosystem. For an organism, it is the amount of energy being absorbed (e.g., food) in relation to the amount of energy expended and lost as heat.

Environment: The physical conditions that exist within an area (e.g., the area that will be affected by a proposed project), including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance. The sum of all external conditions that affect an organism or community to influence its development or existence.

Environmental Assessment (EA): A concise public document, for which a federal agency is responsible, that serves to: (1) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact; (2) aid an agency's compliance with the National Environmental Policy Act when no environmental impact statement is necessary; and, (3) facilitate preparation of an environmental impact statement when one is necessary.

Environmental Justice: The fair treatment and meaningful involvement of all people, regardless of natural origin or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order 12898 directs federal agencies to achieve environmental justice as part of their missions by identifying and addressing disproportionately high adverse effects of agency programs, policies, and activities, on minority and low-income populations.

Environmental Impact Statement (EIS): An analytical document prepared under the National Environmental Policy Act (NEPA) that portrays the potential impacts to the environment of a Preferred Action and its possible alternatives. An EIS is developed for use by decision-makers to weigh the environmental consequences of a potential decision.

Erosion: The wearing away of the land surface by running water, wind, ice, or other geologic agents, including gravitation creep.

Eskimo: An ethnonym (name given to a group by another group) referring to speakers of the Inuit language family who live in the Arctic and Subarctic regions of North America (e.g., Canada, Greenland, and Alaska) and eastern Siberia.

Essential Fish Habitat (EFH): As defined by Congress in the interim final rule (62 FR 66551): "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." For the purpose of interpreting the definition of EFH habitat, "waters" include aquatic areas and their associated physical, chemical, and biological properties; "substrate" includes sediment underlying the waters; "necessary" refers to the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers all habitat types utilized by a species throughout its life cycle.

Estuary: An estuary is a partially enclosed body of water formed where freshwater from rivers and streams flows into the ocean, mixing with the salty seawater. Estuaries and the lands surrounding them are places of transition from land to sea, and from fresh to salt water.

Ethnographic: Of or pertaining to the descriptive and analytical study of the culture of particular self-defined groups or communities.

Exception: A one-time exemption to a lease stipulation determined on a case-by-case basis.

Exploration: The search for economic deposits of minerals, gas, oil or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking, and/or mapping.

Exploratory unit: Exploratory units normally embrace a prospective area delineated on the basis of geological and/or geophysical inference and permit the most efficient and cost-effective means of developing underlying oil and gas resources.

°F: Degrees Fahrenheit.

Fast-ice zone: Area along the coast covered by sea ice that is continuous with and attached to the shoreline.

Feasible: Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

Final Environmental Impact Statement (Final EIS): A revision of the Draft Environmental Impact Statement that includes public and agency comments on the draft.

Fisheries habitat: Streams, lakes, and reservoirs that support fish populations.

Fishery: The act, process, occupation, or season of taking an aquatic species.

Floodplain: The lowland and relatively flat area adjoining inland waters, including, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year.

Fluvial: Of or relating to a stream or river.

Fossil: Evidence or remnant of a plant or animal preserved in the earth's crust (e.g., skeleton, footprint, or leaf print).

Fossil fuel: Petroleum, natural gas, and coal; fuel derived from biologic material that was deposited into sedimentary rocks.

Frequency: The number of samples in which a plant or animal species occurs divided by the total number of samples.

Fugitive dust: Dust particles suspended randomly in the air, usually from road travel, excavation, and/or rock loading operations.

Game Management Unit (GMU): A geographic division made by the Alaska Department of Fish and Game for the management of fish and wildlife in the State. Different GMUs have different hunting and fishing seasons, bag limits, and other harvest rules.

Geology: The scientific study of the origin, history, and structure of the earth; the structure of a specific region of the earth's surface.

Geomorphic: Pertaining to the structure, origin, and development of the topographical features of the earth's crust.

Gill net: Nets made of one or more layers of mesh, used to catch fish by entanglement as they attempt to swim through the net.

Glacial drift: Unsorted sediments deposited by glaciers and not subsequently reworked by water; coarse-grained materials (e.g., rock and sand) suspended in a fine-grained (e.g., silt) matrix. The term applies to all mineral material transported by a glacier and deposited directly by or from the ice, or by running water emanating from a glacier.

Global warming: An increase over time of the average temperature of the earth's atmosphere and oceans. It is generally used to describe the temperature rise over the past century or so, and the effects of humans on the temperature.

Gray water: Discharge that includes wastewater from any or all of the following: kitchen sink, shower, drinking water, and laundry.

Greenhouse effect: A process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases and is reradiated in all directions. Since part of this reradiation is back toward the earth's surface and the lower atmosphere, it results in an elevation of the average surface temperature above what it would be in the absence of the gases.

Greenhouse gas (GHG): A gas that absorbs and emits thermal radiation within the lowest layers of the atmosphere. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases that are considered air pollutants are carbon dioxide, (CO_2), methane (CH_4), nitrous oxide (N_2O), and chlorofluorocarbons (CFCs).

Groundwater: Water found beneath the land surface in the zone of saturation below the water table.

Habitat: The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions. The place where an organism lives.

Hazardous air pollutants (HAPs): (also known as toxic air pollutants) Those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The Environmental Protection Agency (EPA) is required to control 187 hazardous air pollutants. Examples of HAPs include benzene (found in gasoline), perchlorethlyene (emitted from dry cleaning facilities), and methylene chloride (used as a solvent).

Hazardous waste: As defined by the Environmental Protection Agency, a waste that exhibits one or more of the following characteristics: ignitability, corrosivity, reactivity, and/or toxicity. Hazardous wastes are listed in 40 CFR § 261.3 and 40 CFR § 171.8.

Headwaters: The upper reaches of a stream where the stream forms.

Hydrocarbon: A naturally occurring organic compound comprised of hydrogen and carbon. Hydrocarbons can occur in molecules as simple as methane (one carbon atom with four hydrogen atoms), but also as highly complex molecules, and can occur as gases, liquids, or solids. The molecules can have the shape of chains, branching chains, rings, or other structures. Petroleum is a complex mixture of hydrocarbons.

Hydrologic system: The combination of all physical factors, such as precipitation, stream flow, snowmelt, and groundwater that affect the hydrology of a specific area.

Impermeable: Not permitting passage of fluids through its mass.

Impoundment: The collection and confinement, usually of water (in the case of mining, tailings materials), in a reservoir or other storage area.

Increment: An amount of change from an existing concentration or amount, such as air pollutant concentrations.

Indigenous: Having originated in and being produced, growing, living, or occurring naturally in a particular region or environment.

Indirect impacts: Impacts that are caused by an action, but are later in time or farther removed in distance, although still reasonably foreseeable.

Infrastructure: The underlying foundation or basic framework; substructure of a community (i.e., schools, police, fire services, hospitals, water, and sewer systems).

Insect-relief area: An area of the North Slope with relatively low numbers of insects that is used by caribou for relief from insects.

Interstitial ice: Ice found in cavities or lodged between soil grains or rock crevices.

Irretrievable: A term that applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the wildlife forage production from an area is irretrievably lost during the time an area is used as an oil or gas development site. If the use changes, forage production can be resumed. The production lost is irretrievable, but the act is not irreversible.

Irreversible: A term that applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Isobath: Depth interval contour, as commonly mapped for lake or ocean bottoms.

Jurisdictional wetland: A wetland area delineated and identified by specific technical criteria, field indicators, and other information, for the purposes of public agency jurisdiction. The U.S. Army Corps of Engineers regulates "dredging and filling" activities associated with jurisdictional wetlands. Other federal agencies that can become involved with matters that concern jurisdictional wetlands include the U.S. Department of Interior's Fish and Wildlife Service, the Environmental Protection Agency, and the Natural Resource Conservation Service.

Landfast ice: Stationary ice that is continuous with, and attached to, the shoreline and extends out into the waterbody.

Landform: Any physical, recognizable form or feature on the earth's surface having a characteristic shape, which is produced by natural causes. Landforms provide an empirical description of similar portions of the earth's surface.

Land management: The intentional process of planning, organizing, programming, coordinating, directing, and controlling land use actions.

Landscape: The sum total of the characteristics that distinguish a certain area on the earth's surface from other areas; these characteristics are a result not only of natural forces, but also of human occupancy and use of the land. An area composed of interacting and interconnected patterns of habitats (ecosystems), which are repeated because of geology, landforms, soils, climate, biota, and human influences throughout the area.

Land status: The ownership status of lands.

Land use allocation: The assignment of a management emphasis to particular land areas with the purpose of achieving the goals and objectives of some specified use(s) (e.g., campgrounds, wilderness, logging, and mining).

Laterally discontinuous: Not continuous in the horizontal plane. For example, in an area with laterally discontinuous permafrost, the permafrost is not uniformly found across the entire area without interruption.

Lead: Long cracks in the ice, used by both whales and boats to travel through the water.

Listed species: Species that are listed as threatened or endangered under the Endangered Species Act of 1973 (as amended).

Long-term impacts: Impacts that normally result in permanent changes to the environment. An example is the loss of habitat due to development of a gravel pit. For each resource, the definition of long-term may vary.

Maktak: Eskimo delicacy consisting of the skin and the thin layer of subcutaneous fat of whales.

Management activity: A human activity imposed on a landscape for the purpose of harvesting, traversing, transporting, or replenishing natural resources.

Management area: An area delineated on the basis of management objective prescriptions.

Management concern: An issue, problem, or condition that influences the range of management practices identified in a planning process.

Management direction: A statement of multiple use and other goals and objectives, and the associated management prescriptions, standards, and guidelines for attaining them (36 CFR § 219.3).

Marine: Of, found in, or produced by the sea.

Masu: A starchy tuber found in arctic and subarctic regions (vernacular is "Eskimo potato").

Mean: A statistical value calculated by dividing the sum of a set of sample values by the number of samples. Also referred to as the arithmetic mean or average.

Modification: A change to a lease stipulation either temporarily or for the life of the lease.

Migratory: Moving from place to place, daily or seasonally.

Mitigation: Steps taken to: (1) avoid an impact altogether by not taking a certain action or parts of an action; (2) minimize an impact by limiting the degree or magnitude of the action and its implementation; (3) rectify an impact by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate an impact over time by preserving and maintaining operations during the life of the action; and, (5) compensate for an impact by replacing or providing substitute resources or environments (40 CFR Part 1508.20).

Memorandum of Understanding (MOU): Usually documents an agreement reached among federal agencies.

National Environmental Policy Act (NEPA): An act declaring a national policy to encourage productive and enjoyable harmony between humankind and the environment; promote efforts to prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity; enrich the understanding of the ecological systems and natural resources important to the nation; and establish a Council on Environmental Quality.

Net present value (NPV): The difference between the discounted value (benefits) of all outputs to which monetary values or established market prices are assigned and the total discounted costs of managing the planning area.

National Pollutant Discharge Elimination System (NPDES): A program authorized by sections 318, 402, and 405 of the Clean Water Act, and implemented by regulations 40 CFR § 122. The NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.

No-Surface-Occupancy (NSO): An area that is open for mineral leasing but does not allow the construction of surface oil and gas facilities in order to protect other resource values.

Non-Associated Gas: Gas in a reservoir having little or no crude oil.

NO_x: Mono-nitrogen oxides, including nitric oxide (NO) and nitrogen dioxide (NO2). It is formed when naturally occurring atmospheric nitrogen and oxygen are combusted with fuels in automobiles, power plants, industrial processes, and home and office heating units.

Objective: A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used to achieve identified goals.

Oiled: Having oil on skin, fur, or feathers after coming into contact with an oil spill.

Ozone: Form of oxygen found largely in the stratosphere; a product of the reaction between ultraviolet light and oxygen.

Particulates: Small particles suspended in the air, generally considered pollutants.

Pelagic: Pertaining to the ocean and especially to animals (typically marine mammals, birds, or fish) that live at the surface of the ocean away from the coast.

Per capita income: Total income divided by the total population.

Performance-based stipulation: A stipulation applied to a lease that provides a stated objective that must be met, along with requirements and guidelines, but provides some leeway as to how that objective can be met and maintained by the lessee; compare to prescriptive-based stipulation.

Permafrost: Permanently frozen ground.

Permanent oil and gas facilities: Production facilities, pipelines, roads, airstrips, production pads, docks, seawater treatment plants, and other structures associated with oil and gas production that occupy land for more than one winter season. Material sites and seasonal facilities, such as ice roads, are excluded, even when the pads are designed for use in successive winters.

Permeability: The property or capacity of a porous rock, sediment, or soil for transmitting a fluid; a measure of the relative ease of fluid flow under unequal pressure.

Photoperiod: In reference to cycles of light and darkness, the length of time that uninterrupted light is present, generally the length of daylight in a given 24-hour period.

Physiographic province: A region having a particular pattern of relief features or land forms that differs significantly from that of adjacent regions (e.g., Arctic Coastal Plain).

Pingo: A low conical hill or mound forced up by hydrostatic pressure in an area underlain by permafrost and consisting of an outer layer of soil covering a core of solid ice. Pingos range from 6 to 160 meters in height.

Planning area: An administrative unit determined by the Bureau of Land Management based on resources and management issues.

Plant community: A vegetation complex, unique in its combination of plants, which occurs in particular locations under particular influences. A plant community is a reflection of integrated environmental influences on the site, such as soils, temperature, elevation, solar radiation, slope aspect, and precipitation.

Pollution: Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment that produce undesired effects.

Polygon: A surface landform resulting from repeated freeze-thaw cycles common in permafrost areas. Polygons are bounded by troughs of ice or water and generally occur in networks that form regular geometric designs with multiple square sides of nearly equal lengths.

Polynyas: Non-linear openings in the sea ice.

Pool: A subsurface oil accumulation.

Porosity: The ratio of the volume of void space in a material (e.g., sedimentary rock or sediments) to the volume of its mass.

Potable: Suitable, safe, or prepared for drinking, as in potable water.

Pot hunting: The removal or theft of artifacts from cultural resource sites by untrained individuals for profit and recreation.

Prescriptive-based stipulation: A stipulation applied to leases with exacting requirements applying to lessee activities; compare to performance-based stipulation.

Prevention of significant deterioration (PSD): A special permit procedure established in the Clean Air Act, as amended, used to ensure that economic growth occurs in a manner consistent with the protection of public health and preservation of air quality related values in national special interest areas.

Pristine: Pure, original, and uncontaminated.

Prospect: An area of exploration in which hydrocarbons have been predicted to exist in commercially recoverable quantities.

Public scoping: A process whereby the public is given the opportunity to provide oral or written comments about the influence of a project on an individual, the community, and/or the environment.

Pulse: A group of whales; the term is applied to whales migrating across the Chukchi and Beaufort seas, when there are more individuals in each pod of whales and more pods than usual.

Putrescible: Liable to decay.

Pyrogenic: Producing or produced by heat.

Raptor: Bird of prey; includes eagles, hawks, falcons, and owls.

Recharge: Absorption and addition of water into the zone of saturation.

Record of Decision (ROD): A document separate from, but associated with, an Environmental Impact Statement, which states the decision, identifies alternatives (specifying which were environmentally preferable), and states whether all practicable means to avoid environmental harm from the alternative have been adopted, and, if not, why not (40 CFR § 1505.2).

Recoverable reserves: Oil and gas reserves that may be recoverable by the application of technology, but not necessarily commercially recoverable.

Regulated air pollutants: Pollutants first set forth in the Clean Air Act (CAA) of 1970 and are the basis upon which the Federal government and state regulatory agencies have established emission thresholds and regulations. Regulated air pollutants include criteria air pollutants, hazardous air pollutants (HAPs), volatile organic compounds (VOCs), and greenhouse gases. The same pollutant may be regulated under more than one of the regulatory standards.

Reservoir (oil or gas): A subsurface body of rock having sufficient porosity and permeability to store and transmit fluids. Sedimentary rocks are the most common reservoir rocks because they have more porosity than most igneous and metamorphic rocks and form under temperature conditions at which hydrocarbons can be preserved. A reservoir is a critical component of a complete petroleum system.

Resident: A species that is found in a particular habitat for a particular time period (e.g., winter resident or summer resident) as opposed to a species found only when passing through during migration.

Resource Management Plan (RMP): Comprehensive land management planning document prepared by and for the Bureau of Land Management's administered properties under requirements of the Federal Land Policy and Management Act. Bureau of Land Management lands in Alaska were exempted from this requirement.

Required Operating Procedure (ROP): Procedures carried out during proposal implementation which are based on laws, regulations, executive orders, BLM planning manuals, policies, instruction memoranda, and applicable planning documents.

Rideup: A raised-relief ice formation that is formed when a moving ice sheet is forced up and over other structures such as land or ice.

Riffles: Stream segments where the water is relatively shallow, current velocity is relatively high, and sediments are coarse; riffles are located in between areas of deeper, slower water (pools).

Rift zone: Zone of faulting where rocks are pulled apart.

Riparian: Occurring adjacent to streams and rivers and directly influenced by water. A riparian community is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water or conditions more moist than that normally found in the area.

Risked mean: The arithmetic average of all possible resource outcomes weighted by their probabilities. Risked (unconditional) estimates of resources such as oil or natural gas consider the possibility that the area may be devoid of those resources. Statistically, the risked mean may be determined through multiplication of the mean of a conditional distribution by the related probability of occurrence.

Rolligon: A brand name or make of wheeled vehicle that exerts low pressure on the ground, and is designed to travel across sensitive areas such as tundra with minimal disturbance.

Satellite field: An oil reserve located near an existing oil development, allowing shared use of the infrastructure.

Scenic River: River designation, under the Federal Wild and Scenic Rivers Program, on the basis of undisturbed and scenic character. Scenic rivers are given special management criteria by federal agencies.

Scoping process: A part of the National Environmental Policy Act process; early and open activities used to determine the scope and significance of the issues, and the range of actions, alternatives, and impacts to be considered in an Environmental Impact Statement (40 CFR § 1501.7).

Sediments: Unweathered geologic materials generally laid down by or within waterbodies; the rocks, sand, mud, silt, and clay at the bottom and along the edge of lakes, streams, and oceans.

Seismic: Relating to or denoting geological surveying methods involving vibrations produced artificially by explosions.

Sensitive species: Plant or animal species that are susceptible or vulnerable to activity impacts or habitat alterations. Species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species.

Setback: A distance by which a structure or other feature is set back from a designated line.

Short-term impacts: Impacts occurring during project construction and operation, and normally ceasing upon project closure and reclamation. For each resource, the definition of short-term may vary.

Significant: The description of an impact that exceeds a certain threshold level. Requires consideration of both context and intensity. The significance of an action must be analyzed in several contexts, such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts, which should weighted along with the likelihood of its occurrence.

SO_x: Sulfur oxides, including sulfur dioxide (SO2). A product of vehicle tailpipe emissions.

Sociocultural: Of, relating to, or involving a combination of social and cultural factors.

Socioeconomic: Pertaining to, or signifying the combination or interaction of social and economic factors.

Soil horizon: A layer of soil material approximately parallel to the land surface that differs from adjacent genetically related layers in physical, chemical, and biological properties.

Solid waste: Garbage, refuse, and/or sludge produced during oil and gas exploration and development activities.

Spawning: Production, deposition, and fertilization of eggs by fish.

Special use permit: A permit issued under established laws and regulations to an individual, organization, or company for occupancy or use of federal or state lands for some special purpose.

Spill Prevention Control and Countermeasure Plan (SPCC): A plan that the Environmental Protection Agency requires to be on file within six months of project inception. It is a contingency plan for avoidance of, containment of, and response to spills or leaks of hazardous materials.

Spine road: The existing all-season gravel road connecting the oil and gas facilities at Kuparuk (Kuparuk Base Camp) with those at Prudhoe Bay (Prudhoe Bay Operations Center).

Standard: A model, example, or goal established by authority, custom, or general consent as a rule for the measurement of quantity, weight, extent, value, or quality.

Stipulation: A requirement or condition placed by the Bureau of Land Management on the leaseholder for operations the leaseholder might carry out within that lease. The Bureau of Land Management develops stipulations that apply to all future leases within the National Petroleum Reserve-Alaska.

Stratigraphic trap: An oil or gas reservoir in which the hydrocarbons are trapped because of a lateral change in the physical characteristics of the reservoir or a change in the lateral continuity of the rocks.

Strike: The act of throwing a darting gun harpoon with a black powder or penthrite bomb into a whale. A strike may or may not result in a dead whale, which may or may not result in a landed whale. The International Whaling Commission considers and counts the number of strikes and landed whales in their quota allocation to the U.S. government (and hence to the Alaska Eskimos). Unused strikes can be transferred to other individuals or groups harvesting whales.

Subsistence: Harvesting of plants and wildlife for food, clothing, and shelter. The attainment of most of one's material needs (e.g., food and clothing materials) from wild animals and plants.

Talik: An unfrozen section of ground found above, below, or within a layer of discontinuous permafrost. These layers can also be found beneath waterbodies in a layer of continuous permafrost.

Technically recoverable: Amount of oil or gas that can be recovered from a formation using current technology and practices.

Terrestrial: Of or relating to the earth, soil, or land; inhabiting the earth or land.

Thermokarst: Land-surface configuration that results from the melting of ground ice in a region underlain by permafrost. In areas that have appreciable amounts of ice, small pits, valleys, and hummocks form when the ice melts and the ground settles unevenly.

Threatened species: A plant or animal species likely to become an endangered species throughout all or a significant portion of its range within the foreseeable future.

Timing Limitation (TL): This stipulation, a moderate constraint, is applicable to fluid mineral leasing, all activities associated with fluid mineral leasing (e.g., truck-mounted drilling and geophysical exploration equipment off designated routes, and construction of wells and pads), and other surface-disturbing activities (i.e., those not related to fluid mineral leasing). Areas identified for TL are closed to fluid mineral exploration and development, surface-disturbing activities, and intensive human activity during identified time frames. This stipulation does not apply to operation and basic maintenance, including associated vehicle travel, unless otherwise specified. Construction, drilling, completions, and other operations considered to be intensive are not allowed. Intensive maintenance, such as workovers on wells, is not permitted. TLs can overlap spatially with no surface occupancy and controlled surface use, as well as with areas that have no other restrictions.

Total petroleum system: The combination of geologic components and processes necessary to generate and store hydrocarbons, including a mature source rock, migration pathway, reservoir rock,

trap, and seal. Includes all the petroleum generated by related source rocks and resides in a volume of mappable rocks. Geologic processes act upon the petroleum system and control the generation, expulsion, migration, entrapment, and preservation of petroleum.

Traditional knowledge: An intimate understanding by indigenous peoples of their environment, which is grounded in a long-term relationship with the surrounding land, ocean, rivers, ice, and resources. This understanding includes knowledge of the anatomy, biology, and distribution of resources; animal behavior; seasons, weather, and climate; hydrology, sea ice, and currents; how ecosystems function; and the relationship between the environment and the local culture.

Transfer payment: Money given by the government to citizens, such as Social Security, welfare, and unemployment compensation.

Trophic system: The process and organisms that move food energy through the ecosystem, often termed a food chain.

Tundra: Level or undulating treeless plain characteristic of northern Arctic regions, consisting of black mucky soil with permanently frozen subsoil and a dense growth of mosses, lichens, dwarf herbs, and shrubs.

Turbidity: A measure of the amount of suspended sediment in water.

Tussock: A small area of grass that is thicker or longer than the grass growing around it.

Unavailable: When referring to oil and gas leasing, unavailable lands would not be offered for oil and gas leasing.

Unconventional oil and gas: Reservoir oil and gas that cannot be efficiently extracted using conventional methods, examples include shale gas and tar sands.

Vibroseis: A device which uses a truck-mounted vibrator plate coupled to the ground to generate a wave train up to seven seconds in duration and comprising a sweep of frequencies. The recorded data from an upsweep or downsweep (increasing or decreasing frequency respectively) are added together and compared with the source input signals to produce a conventional-looking seismic section. The device is used increasingly in land surveys instead of explosive sources.

Volatile Organic Compounds (VOCs): A group of chemicals that react in the atmosphere with nitrogen oxides in the presence of sunlight and heat to form ozone. VOCs contribute significantly to photochemical smog production and certain health problems. Examples of VOCs are gasoline fumes and oil-based paints.

Waiver: A permanent exemption to a stipulation or lease.

Waterflooding: The injection of water into geological reservoirs to maintain or increase pressure in the reservoir and thereby assist in the extraction of oil.

Water quality: The interaction between various parameters that determines the usability or non-usability of water for on-site and downstream uses. Major parameters that affect water quality include:

temperature, turbidity, suspended sediment, conductivity, dissolved oxygen, pH, specific ions, discharge, and fecal coliform.

Wetlands (biological wetlands): Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include habitats such as swamps, marshes, and bogs (see jurisdictional wetlands).

Wildcat play: An unproven and prospective area of oil and gas potential that is outside of existing oil- and gas-producing areas or zones.

Wilderness: Land designated by Congress as a component of the National Wilderness Preservation System. For an area to be considered for Wilderness designation it must be roadless and possess the characteristics required by section 2(c) of the Wilderness Act of 1964. These characteristics are: (1) naturalness—lands that are natural and primarily affected by the forces of nature; (2) roadless and having at least 5,000 acres of contiguous public lands; and (3) outstanding opportunities for solitude or primitive and unconfined types of recreation. In addition, areas may contain "supplemental values," consisting of ecological, geological, or other features of scientific, educational, scenic, or historical importance.